SUMMARY REPORT

RCRA Facility Investigation

The Doe Run Company
Buick Resource Recovery Facility
Boss Missouri

March 1994

Barr
Engineering Company

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1.0 INTRODUCTION

This report presents a summary of the results of the Resource Conservation and Recovery Act (RCRA) Facility Investigation at the Doe Run Company's (Doe Run) Buick Resource Recovery Facility. The RCRA Facility Investigation at Doe Run's Buick Resource Recovery Facility (the Buick Facility RFI) has been conducted and the investigation report has been prepared pursuant to Special Permit Condition VII of the September 1989 Part B RCRA Permit for the Resource Recycling Facility.

The Buick Facility RFI was conducted during 1993 and the first quarter of 1994 in general accordance with the November 1991 "Revised RCRA Facility Investigation Work Plan." The scope of the investigation was modified based on an August 27, 1992 letter from Lyndell Harrington of the U.S. EPA to Michael Kearney of Doe Run and subsequent correspondence with the U.S. EPA and the Missouri Department of Natural Resources (MDNR).

This RFI Summary Report briefly describes the procedures, methods, and results of the RFI investigation and summarizes information necessary to decide whether an evaluation of corrective measures is necessary for solid waste management units (SWMUs) and areas of concern (AOCs) at the facility. This report is based on the Buick Facility RFI Report (Barr, March 1994) which is being published concurrently.

1.1 <u>Report Organization</u>

This Buick Facility RFI Summary Report is presented in the following sections:

- Executive Summary
- Section 1.0: Introduction
- Section 2.0: Investigation Methods

- Section 3.0: Interim Measures
- Section 4.0: Health and Environmental Assessment
- Section 5.0: Preliminary Scoping of Corrective Measures Study
- Section 6.0: References

This section of the report describes the report organization, facility history, RFI scope and objectives, and supporting documentation.

Section 2.0 briefly describes the methods and results for the investigations of surface water and sediment, soil, groundwater, and air.

Section 3.0 provides a brief description of interim measures that have been completed or are ongoing at the Buick Facility. A more complete documentation of interim measures will be included in the Interim Measures Report following completion of the interim measures.

Section 4.0 presents an assessment of potential health and environmental issues for the Buick Facility, including descriptions of the extent of contamination, potential migration pathways, and potential receptors.

Section 5.0 proposes a framework for evaluating corrective measures, and outlines the scope and schedule for preparation of a corrective measures study plan if U.S. EPA and Missouri DNR determine that a corrective measures study is necessary.

1.2 <u>Facility Description and History</u>

The Doe Run Company's Buick Facility is located near Bixby, Missouri, as shown on Figure 1. Figure 2 is a site plan of the Buick Facility. The Buick Facility consists of the Resource Recycling Division secondary lead recycling facility, primary lead smelting equipment, and associated materials handling equipment, storage areas, and wastewater treatment facilities. The Resource Recycling Division began production in July 1991. Prior to the construction of the Resource Recycling Division, the Buick Facility was a primary lead smelter.

The primary lead smelter began operating in May 1968 and continued to operate until the construction of the Resource Recycling Division. Since the construction of the Resource Recycling Division, the primary smelter only operates intermittently, primarily to supply sinter to Doe Run's primary smelter at Herculaneum, Missouri. The primary smelting portion of the facility processes concentrates mined from the New Lead Belt of southeast Missouri. These concentrates contain high percentages of lead; low concentrations of silver, copper, and zinc; and trace amounts of nickel, cobalt, and arsenic. The primary smelter has a nominal capacity of 135,000 tons of lead per year. By-products of the smelting process are copper matte and sulfuric acid.

The Resource Recycling Division processes automotive and industrial batteries, lead drosses, lead fume, and lead-contaminated wastes into metallic lead and lead alloy, polypropylene plastic, sodium sulfate, and residual materials. The processing is primarily completed in the breaking/ desulfurizing/ crystallization (BDC) building and in secondary lead smelting equipment located adjacent to the primary refinery. The secondary lead smelter is designed to process approximately 180,000 tons of raw materials per year, with maximum production of 90,000 tons of lead and lead alloy per year along with other marketable by-products. The nominal expected capacity is 75,000 tons of finished lead per year.

The site plan of the Buick Facility (Figure 2) shows the location of the BDC building and various components of the primary and secondary smelters including the sinter plant, blast furnace, dross and acid plants, wastewater treatment plant, and refinery.

1.3 Supporting Documentation

The Buick Facility RFI is the third step in fulfilling the corrective action conditions required under Special Permit Condition VII. The initial phases of the corrective action process were development of the RCRA Facility Assessment (RFA) and the RCRA Facility Investigation Work Plan.

The Revised RFA Report (Barr, September 1989) presented information that describes SWMUs and AOCs in terms of the characteristics of each of unit, waste disposal history and waste characteristics, evidence of release of hazardous constituents, hazardous constituents pathways, interim control and remediation measures, and exposure potential. Data presented in the Revised RFA Report suggests that there is a potential for release of heavy metals to surface water and sediment, soil, groundwater, and air from some of the SWMUs and AOCs. The report also states that organic compounds associated with petroleum products (waste lubricants and fuel oils) may also have been released to localized areas.

The Revised RFI Work Plan (Barr, November 1991) described the investigation methods for the Buick Facility RFI, including the characterization of surface water and sediment, soil, cover soil, groundwater, and air as related to the possible release of metals and petroleum products to the environment. The scope of the Buick Facility RFI was modified prior to initiating the investigation based on U.S. EPA and MDNR comments in an August 27, 1992 letter to Doe Run. The scope of the investigation was further modified prior to and during completion of the investigation based on meetings, written and verbal correspondence between U.S. EPA, MDNR, Doe Run, and Barr Engineering.

1.4 RCRA Facility Investigation Scope and Objectives

The scope and objectives of the Buick Facility RFI were developed to fulfill the requirements of the facility's Part B RCRA Permit. The Buick Facility RFI was conducted to characterize surface water and sediment, soil, cover soil, groundwater, and air with regard to the potential release of heavy metals and other possible contaminants from SWMUs and AOCs located within the facility. The goal of the field investigations and other documentation was to determine the extent of releases from SWMUs and AOCs, if any; the extent of migration of the released hazardous wastes or hazardous constituents; and the concentrations of any released constituents in the various environmental media.

Table 1 lists the SWMUs and AOCs identified in the Special Permit Condition VII along with the SWMUs and AOCs identified subsequent to publication of the permit. The locations of the SWMUs and AOCs are shown on Figure 3. Table 1 summarizes the status of each SWMU and AOC and indicates whether it was included in the scope of the RFI. The SWMUs and AOCs are described in the Revised RFA Report (Barr, September 1989) and the Revised RFI Work Plan (Barr, November 1991).

Of the 38 SWMUs and AOCs identified in Section A of Special Permit Condition VII and the 6 SWMUs and AOCs identified subsequent to publication of the permit, 22 were identified as having the potential for impacting stream water and sediment, surface water, groundwater, soil, and air quality. The Buick Facility RFI focuses on determining the impact of waste disposal and materials storage for these 22 SWMUs and AOCs on the surrounding environment.

The slag storage area (SWMU 18) has been previously investigated under the terms of a settlement agreement with the state of Missouri and so was not investigated further in the RFI. A closure plan for the slag storage area was proposed in the July 1991 Metallic Minerals Waste Management Permit Application (Barr Engineering Company [Barr], 1991). The permit was issued by Missouri DNR on January 13, 1992. The approved closure plan should be adopted for management of the slag storage area. An approach for utilizing material from the slag storage area for beneficial use is described in Section 5.0 of this report.

2.0 INVESTIGATION METHODS

2.1 Surface Water and Sediment Characterization

The purpose of the surface water and sediment characterization was to assess the concentrations of metals in stormwater runoff and sediment in order to determine if water or sediment in the East and West Forks of Crooked Creek (tributaries of the Meramec River) have been impacted by discharges of treated wastewater and stormwater and/or stormwater runoff from areas of particulate deposition from the facility. As the U.S. EPA requested in an April 14, 1993 meeting, samples of water and sediment from the Sanitary Wastewater Lagoon (SWMU 24) were also collected.

Sediment samples were collected from four sites on each fork of Crooked Creek. The sites were relocated below the impoundment spillways and above the confluence of the East and West Forks, just south of Highway 32. Sampling locations were chosen based on geographic coverage and sediment distribution. Samples were collected from the top of the stream bottom to a depth of approximately 2 inches, using a stainless steel spatula.

Stormwater runoff samples were collected at the same eight sediment sampling locations on the East and West Forks of Crooked Creek. Two sampling events were conducted during rainfall events heavy enough to produce runoff, on May 10 and May 18, 1993. Sampling began at the upstream station approximately one-half hour after the onset of precipitation. All samples were collected over a two-hour period, during which the rain continued.

One sediment sample and one water sample were collected from the Sanitary Wastewater Lagoon (SWMU 24) to determine if further investigation of this SWMU is necessary. The sediment sample was collected using a 20-foot recovery probe that was advanced with a hammer approximately 12 inches into the bottom sediments of the pond.

2.2 Soils Characterization

The goals of the soil characterization were to determine the soil quality and physical characteristics of soils associated with several SWMUs and AOCs at the Buick Facility; determine the extent of releases, if any, from the SWMUs and AOCs; and assess the potential for migration of hazardous substances from the SWMUs/AOCs. The characterization consisted of a soil boring investigation and a landfill cover soil evaluation.

Soil Boring Investigation

The Revised RFI Work Plan (Barr, November 1991) identified the following SWMUs and AOCs for inclusion in the soil boring investigation.

- SWMU 2 (Closed Construction Debris Landfill)
- SWMU 4 (Closed Landfill Southwest of Impoundment E)
- SWMU 6 (Closed Landfill West of Impoundment E)
- SWMU 7 (Boneyard)
- SWMU 29/37 (Former Fuel Storage Tanks)
- SWMU 32 (Copper Matte Storage Area)
- SWMU 35 (Area North of the Laboratory)
- SWMU 36 (Area South of the Refinery)
- AOC A (Fill North of Impoundment A Dam)
- AOC B (Fill Northeast of the Powder Magazine)

Following the receipt of comments via an August 27, 1992 letter to Doe Run from U.S. EPA approving the RFI Work Plan, and an April 14, 1993 meeting with the U.S. EPA, Doe Run added the following SWMUs and AOCs to the scope of the investigation.

- SWMU 3 (Former Incinerator)
- SWMU 5 (Closed Landfill Southeast Of Impoundment E)
- SWMU 13 (Acid Spill Berm)
- SWMU 14 (Scrubber Sludge Solids Pile or "Rice Paddies")
- SWMU 16 (Impoundment Solids Storage Area)
- SWMU 19 (Impoundment D)
- SWMU 20 (Impoundment E)
- SWMU 30 (Transformers Containing PCBs)
- SWMU 31 (Covered Storage Building)
- SWMU 33 (Charging Area)
- SWMU 40 (Closed Landfill Northeast of Impoundment B)
- AOC BDC (Native Fill Moved During Construction of the BDC Building)
- AOC C (Area East of the Sedimentation Chamber)

The methods in the soil boring investigation included selecting soil boring locations, installing soil borings, collecting soil samples, classifying soil samples, and analyzing soil samples using field and laboratory techniques.

Cover Soil Evaluation

The goal of the cover soil evaluation was to characterize the performance of the existing cover soils on former landfill SWMUs 2, 4, and 6 in terms of impeding infiltration and maintaining slopes. The evaluation consisted of a field investigation, field and laboratory testing, and rainfall infiltration modeling.

The evaluation of the landfills' cover soil consisted of determining existing cover soil thickness, observing general conditions of the cover soils, collecting and testing soil samples, and conducting field testing of density. Compaction tests were performed on the SWMU cover soils using both the sand cone method and the nuclear method. Laboratory tests were conducted on soil samples collected from the existing cover soil to determine the following properties: Atterberg Limits, Standard Proctor maximum dry density, grain size distribution (sieve and hydrometer), and hydraulic conductivity. Permeability testing of cover soils was performed using remolded soil samples. Infiltration modeling was performed to estimate the effectiveness of the existing soil covers in preventing infiltration of rainfall.

2.3 Groundwater Characterization

Groundwater characterization activities conducted for the RFI included reviewing and tabulating previously collected hydrogeologic information; evaluating previously existing monitoring wells; collecting additional hydrogeologic data through the installation of monitoring wells, slug tests, and water-level measurements; and conducting groundwater sampling and analyses. Figure 4 shows monitoring well locations at the Buick Facility.

Groundwater samples were collected and analyzed for total metals (antimony, arsenic, cadmium, copper, lead, and nickel) and dissolved lead and cadmium. Wells in the vicinity of suspected releases of petroleum product were analyzed for semivolatile organic compounds and total petroleum hydrocarbons.

2.4 Air Characterization

The air characterization focused on: (1) reviewing the potential effects of lead particulate emissions from the Buick Facility as a whole on air quality in the surrounding area; and (2) evaluating the potential impacts of historical particulate deposition. The methods used in the air characterization included a review of lead monitoring data taken in the vicinity of the Buick Facility, an evaluation of previous air quality modeling studies, and compilation of smelter stack testing data.

2.5 Documentation of Other SWMUs/AOCs

Several active SWMUs and SWMUs that include aboveground structures were not included in the scope of soil sampling specified in the RFI Work Plan. The U.S. EPA requested that sampling data or photographs and text discussion demonstrating the integrity of the SWMUs be provided to support assertions that releases have not occurred from the following SWMUs.

- SWMU 15 (Scrubber Sump)
- SWMU 22 (Scrubber Solids Thickener System)
- SWMU 23 (Acid Plant Wastewater Neutralization System)
- SWMU 25 (Main Baghouse)
- SWMU 27 (Office Waste Burning Pit)
- SWMU 30 (Transformers Containing PCBs)

SWMU 27 (Office Waste Burning Pit) has been excavated and the material has been placed in Impoundment C which is being managed as part of interim measures at the facility. There is no potential for releases of hazardous constituents from this SWMU.

SWMUs 15, 22, 23, 25, and 30 are engineered structures, located in areas of the facility that are active or that may be reactivated. Each of the SWMUs is designed to limit the potential for a release. Those designs include areas covered with concrete and dust control systems. Except for the Scrubber Sump (SWMU 15), the SWMUs are entirely aboveground making it possible to readily assess whether releases have occurred or are occurring. There is no indication that releases have occurred from any of these units.

3.0 INTERIM MEASURES

Interim measures are ongoing at the Buick Facility. The objectives of the interim measures are to further reduce potential threats to public health and the environment by reducing the areal extent of contaminated materials, manage stormwater from the facility, reduce hydraulic head on contaminated fill by closing surface impoundments, and contain contaminated material in an engineered containment system to reduce the potential for releases or migration. These objectives are being pursued by the following interim measures: (1) closing Impoundments A, B, and C (SWMUs 8, 9 and 10, respectively); (2) placing waste and other materials from other SWMUs in an engineered containment system in Impoundment C; and (3) constructing stormwater tankage to provide stormwater retention and treatment.

The progress of the interim measures have been documented in quarterly reports submitted to the U.S. EPA and Missouri DNR. A final report will be submitted following completion of the project. The schedule for project completion is dependent on the completion of excavating materials from the Boneyard and the former Copper Matte storage area and the capping of the materials placed in the engineered containment system in the area of former Impoundment C. The interim measures are currently expected to be completed by the end of third quarter of 1994.

The Interim Measures Report will describe the evaluation and confirmation sampling procedures, sampling locations, and the sampling results for closure the SWMUs; describe the construction and construction quality assurance of the engineered containment system cap and the new stormwater management facilities; and certify the cap construction.

4.0 HEALTH AND ENVIRONMENTAL ASSESSMENT

This section summarizes the nature and extent of releases to air, soil, sediment and surface water, and groundwater from the Buick Facility, and characterizes the potential pathways and receptors that should be considered in evaluating whether there are any potential risks from the site. Potential pathways and receptors are shown on Figure 5. The measured or predicted concentrations of contaminants in the various media are compared to potential action levels, standards, and guidelines to put conditions at the site into perspective. However, the numerical values are not intended to be specific remediation goals as such goals have not been established for the site.

The primary objective of the pathway screening process is to determine whether a potential pathway is "complete" under current or under reasonable assumptions about future conditions. An exposure pathway is considered to be complete if a linkage can be shown between one or more contaminant sources, through one or more environmental fate and transport process, to an exposure point where human or ecological receptors are present.

4.1 Air

4.1.1 Nature and Extent of Releases

Ambient air lead concentrations were first measured in 1979. Air pollution control equipment has since been installed, and the plant has lowered the emissions of some of the highest emission sources. A Consent Order was developed in 1989 under Missouri's State Implementation Program to limit emissions from the primary and secondary operations consistent with compliance with the National Ambient Air Quality Standards (NAAQS). There have been no monitoring data indicating exceedences of the NAAQS during operation of the secondary plant alone, and future operation of the primary smelter is unlikely. Air lead concentrations thus do not seem problematic at the site.

Particulate lead emission modeling of the Buick Facility was performed by Shell Engineering and Associates, Inc. to predict ambient lead air concentrations and deposition. Three plant configurations were used in the modeling: (1) current operations with actual lead emissions; (2) baseline (maximum production) conditions for the 1992 plant configuration; and (3) a proposed maximum production configuration in which various pollution control equipment would be added or replaced.

Airborne particulate lead deposition to soils was also evaluated using the modeling results. As the modeling was not tied to historic emission rates, the results cannot be used to quantify lead deposition, but do give a qualitative indication of lead particulate deposition. The lead deposition modeling results indicate that airborne particulate lead deposition is greatest at the base of the main stack, decreases rapidly moving away from the stack, and is distributed north-northwest and southeast from the main stack. This is consistent with the predominating wind direction at the facility. The deposition pattern is shown relative to the nearest off-site receptors on Figure 6.

4.1.2 Potential Migration Pathways and Receptors

Pathways

The primary pathway for releases of metal-bearing particulates to air is atmospheric dispersion. A secondary pathway is deposition, with possible subsequent resuspension through wind erosion, vehicle traffic, or excavation activities. Wind erosion of site soils is dependent on the erodibility of the surface material. The site surface material is generally considered to be of "limited erodibility" (e.g., stones, clumps, vegetation). Release of particulates through vehicle traffic and excavation is controlled through application of dust control measures.

As the primary organic compounds at the site were lubricants and fuel oils, the potential for volatilization as a potential exposure pathway is limited.

Potential Receptors

Potential receptors include: (1) site workers and visitors; and (2) off-site receptors, including nearby residents (the nearest dwelling is greater than one mile away from the facility), lumber workers, forest service personnel, hunters and hikers.

Exposure of on-site and off-site receptors could potentially occur through inhalation, ingestion and dermal contact with airborne or deposited metal-bearing particulates.

Exposure potential of on-site workers and site visitors is considered low. Employees and site visitors must adhere to strict personal protection requirements for work in lead areas in conformance with Occupational Safety and Health Administration (OSHA) standards. Exposure of trespassers is considered low since frequency and duration of individual exposure would be low. Additionally, much of the facility is fenced, limiting trespass activity, and an additional boundary fence and restricted access signage is under construction.

The exposure potential for off-site receptors is generally low. This conclusion is based on: (1) the distance to the nearest dwellings; and (2) the results of the ambient monitoring and the predicted (modeled) concentrations for the current conditions, which show compliance with the NAAQS standard for lead. Potential for exposure through direct contact with deposited particulates released from the site through atmospheric dispersion is considered low. Predicted soil deposition at the nearest residence was estimated to be less than 10 percent of the maximum deposition at the facility's fenceline. Exposure of forest users (recreational and occupational) is not considered significant due to the infrequent and short duration of exposures to areas potentially impacted by airborne particulates and deposited material.

4.2 <u>Soil</u>

4.2.1 Nature and Extent of Releases

The locations of the SWMUs/AOCs are shown on Figure 3. Table 2 lists the predominant process materials, wastes, and other contaminated materials present in the SWMUs/AOCs that were characterized during the soils investigation. The SWMUs/AOCs have been placed into categories based on the type of waste or other materials associated with each unit or area. These materials include metals-contaminated native fill, petroleum hydrocarbon contaminated native fill, landfilled debris, slag, recyclable scrubber sludge solids, copper matte, and sinter.

Metals

The SWMUs/AOCs generally contain native or non-native fill underlain by undisturbed residuum. Non-native fill (i.e., waste materials, slag, or sinter) is typically characterized by high concentrations of metals. Native fill (i.e., disturbed and relocated residuum soil) is characterized by metals concentrations that are lower than those in non-native fill but still higher than those in the residuum. The undisturbed residuum generally contains low concentrations of metals.

Non-native fill within each SWMU and AOC is generally characterized by uniform concentrations of metals. Metals concentrations in native fill are not uniform and generally do not decrease significantly with depth, as would be expected if the soil profiles represented migration from sources at the ground surface.

The concentrations of metals generally decrease abruptly at the contact between the fill and the residuum soil. Significant migration into the residuum has not generally been observed and soil characteristics are favorable for the retention of metals in the shallow subsurface.

Landfilled debris present in several of the SWMUs and AOCs was not characterized for metals content. The soil boring investigation of landfill units focused on characterizing the quality of cover soils and soils present beneath the landfilled material. Results indicate that landfill cover soils contain metals concentrations similar to other native fill. Generally, residuum with low metals concentrations is present immediately beneath the landfilled material.

SWMUs 14, 16, 19, and 20 contain little or no native fill and consist largely of waste or process material underlain by residuum with low metals concentrations.

High concentrations of metals other than lead are generally associated with high concentrations of lead. Lead concentrations were less than 200 mg/kg in 65 percent of the residuum samples and greater than 1,000 mg/kg in 13 percent of the residuum samples. The higher lead concentrations in residuum samples were usually for samples that were collected immediately below fill or for samples where cross-contamination during sample collection was suspected. Lead concentrations were greater than 4,000 mg/kg in 85 percent of the non-native fill and native fill samples.

Proposed Subpart S action levels for corrective action at RCRA facilities (Federal Register, July 1990) are used as a basis for comparison for the soils data. The proposed action levels assume exposure through consumption of the soil contaminated with the hazardous constituent under a residential land use scenario with long-term direct contact and soil ingestion by children. This is clearly not an appropriate land use scenario for current conditions and is likely not an appropriate land use scenario for future conditions. As such, the proposed action levels should not be construed as remediation goals or other quantitative targets for corrective action.

Subpart S action levels have been proposed for antimony, arsenic, and cadmium, but not for lead. Some of the samples of the fill had concentrations of these metals (Table 3) in excess of the proposed Subpart S action levels in nearly all SWMUs and AOCs (the exception being SWMUs 19 and 20, from which no fill samples were collected). The proposed Subpart S levels were exceeded most frequently and by the greatest amount for cadmium.

Only a few residuum samples had concentrations of metals which exceeded the proposed Subpart S action levels. Generally, the residuum exceedences were associated with anomalously high lead results and were measured in samples that were collected directly below fill or samples suspected of being cross-contaminated during sample collection.

<u>Organics</u>

Samples collected at locations in SWMUs 5/16, 7, and 29/37, had visible indications of petroleum hydrocarbon releases and were analyzed for semivolatile organic compounds, oil and grease, and/or total petroleum hydrocarbons (TPH), as appropriate.

Several PAHs were detected (Table 4, maximum total PAH concentration of 179 mg/kg) in samples from SWMU 29/37 (Former Fuel Tanks). No PAH constituents were detected above the proposed Subpart S action levels. TPH was detected at concentrations up to 74,000 mg/kg in samples from SWMU 29/37.

Several PAHs were detected at low concentrations (maximum total PAH concentration of 2.6 mg/kg) in samples from one location in SWMU 5/16 (Closed Landfill Southeast of Impoundment E and Impoundment Solids Storage Area). TPH concentrations in these samples ranged from 161 mg/kg to 1,400 mg/kg. None of the measured PAH concentrations were above the proposed Subpart S action levels.

No PAHs were detected in samples from SWMU 7 (Boneyard). Oil and grease and TPH were detected at concentrations up to 98,000 mg/kg in shallow samples from each of two locations in SWMU 7.

In comparison to metals contamination, which generally extends to the top of the residuum in all SWMUs, organic contamination is confined to shallow depths (less than 4.5 feet) at several locations in SWMU 7. Fuel oil or diesel contamination was detected at a relatively great depth (20 to 28 feet) at one location in SWMU 5/16 but is believed to be due to placement in filled materials rather than migration from the surface. Fuel oil contamination extends to a depth exceeding 10 feet at one location in SWMU 29/37.

Extent of Releases

The limits of the SWMUs/AOCs defined by field observations and historical usage did not always correspond to the extent of high metals concentrations. In some areas, analytical results for samples collected outside SWMU boundaries showed high metals concentrations in the fill. These results may indicate: (1) the metals contaminated fill was moved during plant construction activities from areas originally used for waste or process material storage; (2) deposition of airborne particulates; or (3) a combination of processes. Also, some SWMUs/AOCs are located adjacent to, or overlap, other SWMUs/AOCs, and it is not always possible to clearly distinguish between adjacent SWMUs/AOCs.

4.2.2 Potential Exposure Pathways and Receptors

Pathways

Direct exposure to on-site contaminated soil is the primary potential exposure pathway to hazardous constituents. Surficial soil (depths of up to 12 inches) is the most likely soil depth where direct contact could occur.

Excavation or other activities which disturb the surface soil would be the only mechanism for any possible direct contact with contaminated deeper soil. Secondary pathways such as resuspension were addressed under the characterization of air releases.

Exposure Routes and Exposure Potential

Direct contact with contaminated soil could potentially lead to incidental ingestion, dermal contact, or possibly inhalation if materials were dispersed into the air.

The current potential for exposure due to direct contact with contaminated soil is limited. Site workers and visitors must adhere to strict personal protection requirements in conformance with Occupational Safety and Health Administration (OSHA) standards. Additionally, the facility is fenced, limiting any trespass activity. On-site workers and contractors shower and change clothes on leaving the facility, reducing the possibility of off-site movement by personnel.

The potential for exposure could change upon facility closure and site redevelopment, if any. If the facility were to close, the most likely land-use would be for wildlife management and include hunting, hiking, and other intermittent, short-duration activities. The frequency and duration of contact under these types of land uses would likely be limited.

4.3 Surface Water and Sediment

4.3.1 Extent and Nature of Release

Crooked Creek

The highest concentrations of metals (antimony, arsenic, and lead) measured in sediment samples were from sampling locations on the West Fork of Crooked Creek. The highest concentrations of metals were associated with high percentages of organic material in the sediment.

As no standards or action levels for stream sediment have been established or proposed for the constituents of concern at the site, the Subpart S action levels are used as a basis for comparison. Table 5 lists the measured concentrations of metals in sediment samples. Sample WCC-S3 exceeded the Subpart S action level for antimony. Samples WCC-S2 and WCC-S3 exceeded the Subpart S action level for arsenic. Samples WCC-S1, WCC-S2 and WCC-S3 exceeded the Subpart S action level for cadmium. Samples from location WCC-S4, which is near the property boundary and is the farthest downstream sampling location from the facility on the West Fork, did not have concentrations above the Subpart S action levels. None of the sediment samples collected from the East Fork had concentrations above the Subpart S action levels.

Stormwater quality in the West Fork of Crooked Creek was found to be heavily influenced by the NPDES permitted discharge. However, arsenic, lead, and cadmium concentrations were found to increase between sampling locations WCC-1 (near outfall #001) and sampling locations WCC-2, suggesting either suspension of sediment in the stream or a contribution from runoff containing air-deposited materials into the stream. Metals concentrations decreased significantly to WCC-4, near the property line.

Stormwater quality in the East Fork of Crooked Creek is likely not the result of NPDES-permitted discharge because discharge from outfall #002 did not occur in 1993 prior to or concurrent with stormwater sampling. Concentrations of metals decreased greatly from the upstream sampling location (ECC-1) to the downstream sampling location (ECC-4).

The proposed Subpart S corrective action rules contained an approach to developing action levels for surface waters. The proposed rule specifies that state water quality standards pursuant to Section 3030 of the Clean Drinking Water Act that are expressed as numerical values should be used as action levels, where they have been established for the surface water body in question. In cases where numerical standards have not been established, action levels may be established as numeric interpretations of state narrative water quality standards. The water quality standards establish water quality goals based on the use or uses which the State designates for receiving water.

A downstream reach of Crooked Creek in Crawford and Dent Counties is classified as a Class P stream in Missouri Statute 10 CSR20-7.031 (Table H, Stream Classification and Use Designation). Class P streams are classified as maintaining a permanent flow even during drought. The Buick Facility is approximately four river miles upstream from the upper end of the designated reach of Crooked Creek. As such, the portion of Crooked Creek evaluated in this study does not appear to be covered in the classification. However, for comparative purposes, the classification and standards for the lower reaches of Crooked Creek were used with the stated recognition that the Class P standards are likely not appropriate for the upper portion of Crooked Creek.

Table H of 10 CSR20-7.031 indicates that the classified portion of Crooked Creek is a Class P stream with the following designated use and protection criteria: livestock and wildlife watering; protection of warm water aquatic life and human health by fish consumption; cool water fishery; and whole body contact. The most stringent water-quality criteria stem from livestock/wildlife water and chronic exposure criteria for warm water fisheries. The measured concentrations in stream water samples collected from the two sampling rounds in May 1993 are compared with the Class P surface water standards in Table 6.

As shown in Table 6, the Class P standard for antimony was not exceeded in any samples. The Class P standards for arsenic was not exceeded in the West Fork of Crooked Creek but was exceeded at ECC-2 (during the first sampling round) and at ECC-1 (during the second sampling round) in the East Fork.

The cadmium Class P standard was exceeded in the West Fork of Crooked Creek at several sampling locations. The cadmium concentrations were below the Class P standards at ECC-4 and WCC-4 (near the property line) for both sampling rounds.

The Class P standard for lead was exceeded at all sampling locations during both sampling rounds in the West Fork of Crooked Creek. Lead concentrations at WCC-4 (near the property line) were markedly lower than concentrations detected from up-stream sampling locations. A similar decreasing lead concentration downstream was observed in the East Fork of Crooked Creek. The lead concentration in surface water samples from ECC-4 (near the property boundary) is at or below the Class P standard (depending on the hardness of the water) for both sampling rounds.

Outfall #004 is a water quality monitoring station on Crooked Creek, located approximately one mile downstream (north) of Highway 32. Monthly collection of samples from this location began in January 1993. Samples are analyzed for total arsenic, cadmium, copper, lead, and zinc. None of these constituents have been detected in samples from outfall #004, indicating that the facility is not impacting water quality in downstream reaches of Crooked Creek.

Sanitary Wastewater Lagoons

The sediment sample collected from the Sanitary Wastewater Lagoon (SWMU 24) contained lead and cadmium at concentrations of 39,800 and 1,070 mg/kg, respectively, in the sediment sample. Concentrations of lead and cadmium in the water sample from the lagoon were 1,300 and 530 μg/L, respectively.

The Sanitary Wastewater Lagoon is wholly contained within private property and, as such, does not meet the definition of Waters of the State. Although the proposed Subpart S soil action levels would not be directly applicable to the sediment in the Sanitary Wastewater Lagoon, cadmium is the only constituent with a concentration in the bottom sediment of the lagoon that exceeds the proposed Subpart S action level for soil.

4.3.2 Potential Migration (Exposure) Pathways and Receptors

Heavy metals have been detected in surface water and sediment of the East and West Forks of Crooked Creek within the boundary of the facility. Direct contact with these surface waters and/or sediment during recreational or occupational activities constitutes a potential exposure pathway with exposure via incidental ingestion or dermal contact. Major potential human receptors are, lumber workers, road repair crews, hunters, and hikers. Significant human exposure is unlikely since the area is within the controlled boundary of the facility, flow in the East Fork is intermittent and flow in the West Fork of Crooked Creek is due mainly to the discharge from outfall No. 001 and, therefore, does not constitute a primary source for recreational activities. Any exposures which could occur would be intermittent and of short duration.

Direct contact with surface water or sediment in the Sanitary Wastewater Lagoon is not considered a significant exposure pathway since access to the lagoon is limited by fencing, which limits trespasser access.

4.4 Groundwater

4.4.1 Nature and Extent of Release

Groundwater was found to occur in three units: (1) perched groundwater of limited extent in the upper residuum; (2) saturated portions of the lower residuum/upper bedrock; and (3) bedrock. Perched water in the upper residuum appears to be the result, in part, of leakage from surface impoundments and possibly from water supply piping. Groundwater flow in the lower residuum/upper bedrock is predominantly south-southwest. Mounding conditions in the lower residuum/upper bedrock were noted around Impoundment E and former Impoundment A. Groundwater flow in the bedrock is predominantly west-southwest. Hydraulic conductivity values in the residuum and bedrock are quite low and groundwater velocities are typically less than 1 ft/day. Vertical gradients between units are downward.

Groundwater quality data are shown on Figures 7 through 12. These figures present the groundwater quality data for the residuum, including unfiltered cadmium (Figure 7), unfiltered lead (Figure 8), and unfiltered nickel (Figure 9). The bedrock groundwater quality figures included unfiltered cadmium (Figure 10), unfiltered lead (Figure 11), and unfiltered nickel (Figure 12).

Groundwater quality in the residuum appears to be significantly different than background in the vicinity of Impoundments D, E, and former Impoundment A. Cadmium, nickel, and lead concentrations are somewhat higher in samples from wells screened in the residuum adjacent to these features than in samples from deeper wells. Lead, cadmium, and nickel concentrations were also somewhat higher in samples from wells screened in the perched residuum zone underneath the primary smelter area. Samples from wells screened in the lower residuum/upper bedrock unit and, to a much lesser extent, from wells screened in the bedrock adjacent to the impoundments suggest that lead, cadmium, and nickel have not moved far from the areas of the impoundments and that significant off-site migration of contaminants is not occurring and is not likely to occur in the near future.

Groundwater quality typically exceeded the RCRA Maximum Contaminant Groundwater Limits (MCGLs) and SDWA Maximum Contaminant Limits (MCLs) only in the immediate vicinity of the impoundments.

4.4.2 Potential Migration (Exposure) Pathways and Receptors

<u>Potential Pathways</u>

Metals appear to have been released to the groundwater in the vicinity of Impoundments D, E, former Impoundment A, and the primary smelter area. The constituents are largely in the perched residuum zone, with lower concentrations in the lower residuum/upper bedrock and, to a small degree, the bedrock. Metals in water infiltrating into the residuum are attenuated significantly by the residuum through adsorption and precipitation. Attenuation processes such as diffusion and dispersion affect the mobility and concentration of the metals in the upper aquifer. The affected groundwater units are not currently used as a potable water source for the facility. Off-site migration of contaminants in groundwater has not occurred and is not likely to occur in the near future due to the relatively large size of the site and the relatively low groundwater velocities. Doe Run has sampled a domestic well located 1.2 miles northwest of the site. Concentrations of all metals were below detection limits in samples from this well.

Under present conditions, the groundwater exposure pathway is not considered to be complete and does not pose a risk to on- or off-site receptors. The exposure potential under future conditions is considered to be low due to the distance to the nearest water supply wells (1.2 miles) and the nature of the residuum soils and bedrock, which limit the rate of migration of hazardous constituents and provides significant attenuation.

Any springs/ponds/creeks etc?

5.0 PRELIMINARY SCOPING OF CORRECTIVE MEASURES STUDY

This section outlines the subsequent steps of the RCRA Corrective Action process and outlines an overall approach for evaluating alternatives for corrective action, if such an evaluation of corrective actions is required.

5.1 Corrective Action Process

The next step in the corrective action process under the facility's permit is evaluating potential corrective action alternatives in a "Corrective Measures Study" (CMS). Special Permit Condition VII.K.1 of the Buick Facility's Part B RCRA Permit describes how the need to evaluate appropriate corrective measures for individual solid waste management units (SWMUs) and areas of concern (AOCs) will be determined by the U.S. EPA and the Missouri DNR following their review of the RFI report. Some units and areas may not require further action if there are no releases of hazardous wastes or hazardous constituents that pose a threat to human health or the environment. In such cases, the corrective action process should be terminated for those specific units and areas and a "determination of no further action" made. In other cases, a streamlined corrective action approach similar to that used for the interim measures activities may be appropriate.

If a CMS is required for specific SWMUs or AOCs, the facility's permit outlines a two-step process for the evaluation. The first step is to prepare a CMS plan within 45 calendar days after notification that a CMS is required (Special Permit Condition VII.K.2). The required contents of the CMS plan are described later in this section. Following U.S. EPA and Missouri DNR approval or modification of the CMS plan, the CMS must be performed according to the schedule specified in the CMS plan. The results of the CMS would be summarized in the CMS Final Report.

U.S. EPA and the Missouri DNR would then review the CMS evaluation and select a remedy (or remedies) from the corrective action alternatives evaluated in the CMS based on the criteria described in Special Permit Condition VII.N. The U.S. EPA's and Missouri DNR's remedy selection(s) would be documented in a Statement of Basis and the facility's permit would be modified to specify the required corrective action.

Corrective action implementation would follow remedy selection, and consist of developing: (1) the corrective action design; (2) operation, maintenance, monitoring, community relations, emergency response, quality assurance, and health and safety plans; (3) a project schedule; (4) detailed plans and specifications; and (5) cost estimates. The design and plans would be reviewed by the U.S. EPA and the Missouri DNR prior to implementation.

Corrective actions would be implemented following U.S. EPA and Missouri DNR review. Construction quality control and documentation and implementation progress reports would be required during implementation.

Following construction, corrective action implementation would be described in a Corrective Measures Implementation Report. The report would describe the construction activities, summarize the construction quality control and confirmation testing, and certification that the constructed project met the design specifications.

5.2 Overall Approach to Corrective Action

Due to its ongoing operations, security to prevent inadvertent site entry, worker exposure safeguards, and remote location, the Doe Run Company's Buick Facility can approach corrective action in a manner which minimizes potential risks to the general public and the environment while maintaining viable business activities and flexible use of the facility. The following paragraphs describe Doe Run's proposed overall approach to corrective action as a preliminary step in scoping the Corrective Measures Study.

5.2.1 Phasing of Corrective Measures

Given the minimal potential for exposure of the general public to releases from the SWMUs under current operating conditions, interim and final corrective actions should be implemented in a manner that is consistent with continued use of the facility. This will allow efficient land use by centralizing continued activities, allow resource recycling technologies to potentially be employed as part of the corrective measures, and reduce the cost to, and interference with, ongoing operations.

In concept, corrective measures would be conducted in phases both geographically and by activity. Geographically, corrective measures would be implemented first at the peripheries of the site and move towards the process areas as site activities diminish and portions of the facility begin to close. Activities would also be phased. The first activities would be actions to further minimize potential for exposure (such as the current fencing program to provide overall site control), followed by containment, stabilization, removal, or closure of individual units, and ultimately partial or complete facility closure. Appropriate monitoring would be conducted consistent with the corrective action activities being performed.

5.2.2 Preference for Resource Recovery and Containment

Corrective actions at the Buick Facility must recognize the immutable nature of the primary hazardous constituents and the large scale of some of the SWMUs and AOCs. Clearly, the preferable approach to addressing the contaminants is beneficial reuse. As an example, processing of the primary smelter slag for sinter over the last 5 years has significantly reduced the volume of slag in the slag disposal area. Doe Run has been investigating methods for extracting lead and zinc from primary blast furnace slag, and during 1994 is expecting to be involved in a major pilot plant effort to confirm the value of the proposed process. The process is the coupling of a Mintech Electric Furnace with an ISP lead splash condenser. If successful and approved, this process would be installed at the Herculaneum primary smelter, and the slag from Buick would ultimately be transferred to Herculaneum for material recovery. A closure decision for the Buick Facility slag pile can only be made after determining the feasibility of the process.

Similarly, metals-bearing materials in the other SWMUs/AOCs may be economically recoverable in the future as technologies develop. Due to this potential and the large scale of the site, corrective action technologies to consolidate and contain the material and allow for its potential recovery are preferred over chemical or physical stabilization or fixation technologies which would reduce or eliminate the potential for future recovery.

5.3 Potential Corrective Action Technologies

Table 7 lists potential corrective action technologies that could be considered if a CMS is required for specific SWMUs or AOCs. The technologies were identified based on the nature of the contaminants, the current and long-term potential for human health and environmental exposure, and the overall approach for corrective action listed above. The technologies would be combined into corrective action alternatives for evaluation in the CMS.

5.4 Approach for Conducting Corrective Measures Study

5.4.1 Submission of Corrective Measures Study Plan

If U.S. EPA and Missouri DNR require preparation of a CMS, a CMS plan will be prepared within 45 calendar days of notification that the plan is necessary. The plan's contents will follow the requirements of Special Permit Condition VII.K, and will: (1) describe the general approach that will be followed in describing current conditions, screening technologies, and developing corrective action alternatives; and (2) define the overall objectives of the CMS.

The facility's permit requires the CMS plan to outline the approach that will be followed in evaluating the alternatives, including: (1) the technical evaluation of effectiveness, reliability, implementability, time required to implement, and safety; (2) the approach to assessing the short- and long-term beneficial and adverse environmental effects, and analyzing potential mitigative measures; (3) a plan for a biological assessment to determine potential impact on Federally-listed threatened or endangered species, if any, and description of how the alternatives would be evaluated so as to promote conservation of species; (4) a procedure for human health evaluation, including the extent to which alternatives mitigate short- and long-term potential exposure to residual contamination and protect human health during and after implementation of corrective measures; (5) a plan for an institutional evaluation assessing the effects of laws, regulation, and guidance on the design, operation, and timing of each alternative; (6) procedures for preparing cost estimates; (7) procedures for developing the scope of the corrective measures implementation plans necessary for each alternative (final design, operation and maintenance, construction cost estimate, construction quality assurance objectives; health and safety plan, and submittals); and (8) an approach for evaluating corrective measures implementation issues for each alternative (responsibility and authority, construction quality assurance personnel qualifications, inspection activities, sampling requirements, and documentation).

The CMS plan will outline the criteria that will be used to justify and recommend a particular corrective action alternative for a specific SWMU or AOC. The criteria will be based on: (1) measures of technical performance, reliability, implementability, and safety; (2) U.S. EPA criteria, standards, or guidelines for protection of human health; and (3) protection of environmental receptors.

The CMS plan will propose a schedule for conducting the CMS and submitting the CMS final report and the proposed format for presentation of the CMS results.

5.5 Recommended Continuing Monitoring

The following monitoring activities should be continued during U.S. EPA's and Missouri DNR's review of the RFI report and preparation of the CMS Plan. Continued monitoring will confirm that conditions do not change significantly between the conclusion of the RFI investigative activities and the in-depth planning of any corrective measures and will produce a larger database over a longer time period so as to better evaluate existing conditions.

5.5.1 Air Monitoring

Ambient air monitoring will be continued under the facility's agreements with the State of Missouri. The monitoring is conducted to confirm continued compliance with the National Ambient Air Quality Standard for lead.

5.5.2 Groundwater Monitoring

Groundwater monitoring should be continued on a semi-annual basis for the RFI and slag storage area monitoring wells monitored for the RFI and will be continued for the BDC building monitoring wells as required under the terms of the facility's permit. Groundwater should be monitored for total metals. RFI monitoring frequency and parameters should be reevaluated and modified as appropriate in the CMS plan.

5.5.3 Surface Water Sampling

Due to the potential variability of stormwater runoff, additional stormwater runoff sampling should be conducted along the East and West Forks of Crooked Creek at least once a year if precipitation sufficient to cause runoff occurs. The stormwater monitoring should be performed consistent with the approach used in the RFI.

6.0 REFERENCES

Barr, 1989. "RCRA Part B Permit Application, Prepared for The Doe Run Company, Buick Resource Recovery Facility." Barr Engineering Company, 1989.

Barr, 1989. "Revised RCRA Facility Assessment Report, The Doe Run Company, Buick Resource Recovery Facility." Prepared by Barr Engineering Company, 1989.

Barr, 1991. "Revised RCRA Facility Investigation Work Plan, The Doe Run Company, Buick Resource Recycling Facility." Prepared for The Doe Run Company, 1991.

Barr, 1994. "RCRA Facility Investigation Report, The Doe Run Company, Buick Resource Recovery Facility." Prepared for The Doe Run Company, 1994.

Summary Report

Tables

TABLE 1

SUMMARY OF SOLID WASTE MANAGEMENT UNITS AND AREAS OF CONCERN

AREA DESIGNATION[1]	FORMER DESIGNATION[3]	DESCRIPTION	SOIL BORINGS COMPLETED	STATUS
SWMU 1	Unit B	Former Baghouse Disposal Area	--	IM
SWMU 2	Unit D	Closed Construction Debris Landfill	7	Inactive
SWMU 3	Unit H	Former Incinerator	3	Removed
SWMU 4	Unit I	Closed Landfill Southwest of Impoundment E	22	Inactive
SWMU 5/16	Units J and K, respectively	Closed Landfill Southeast of Impoundment E (Unit 5) and Impoundment Solids Storage Area (Unit 16)	19	Inactive
SWMU 6	Unit M	Closed Active Landfill West of Impoundment E	6	Inactive
SWMU 7	Unit N	The Boneyard	53	IM
SWMU 8	None	Impoundment A	--	IM
SWMU 9	None	Impoundment B	--	IM
SWMU 10	None	Impoundment C	--	IM
SWMU 11	Unit A	Gypsum Disposal Area	--	IM
SWMU 12	Unit C	Acid Plant Water Discharge Area	--	IM
SWMU 13	Unit E	Acid Spill Berm	3	Active
SWMU 14[4]	Unit F	Sedimentation Chamber and Scrubber Sludge Solids Pile ("Rice Paddies")	4	Closed
SWMU 15[4]	Unit G	Scrubber Sump	--[2]	IM
SWMU 17	Unit L	Sedimentation Chamber	--	Inactive
SWMU 18	Unit O	Slag Storage Area	--	MMWMP
SWMU 19	None	Impoundment D	1	Active
SWMU 20	None	Impoundment E	1	Active
SWMU 21	None	Main Wastewater Treatment Plant	--	Active
SWMU 22[4]	None	Scrubber Solids Thickener System	--[2]	Inactive
SWMU 23[4]	None	Acid Plant Wastewater Neutralization System	--[2]	Inactive
SWMU 24	None	Sanitary Wastewater Lagoons	--	Active
SWMU 25[4]	None	Main Baghouse	--[2]	Active
SWMU 26	None	Stack Crusher Baghouse	--[2]	Active
SWMU 27	None	Office Waste Burning Pit	--	Closed
SWMU 28	None	Baghouse Bag/Equipment Wash Building	--	Active
SWMU 29/37	None	Former Fuel Storage Tanks	8	Removed
SWMU 30[4]	None	Transformers Containing PCBs	--[2]	Active
SWMU 31[4]	None	Covered Storage Building	7	Active

TABLE 1 (Cont.)

SOLID WASTE MANAGEMENT UNIT SUMMARY
THE DOE RUN COMPANY
BUICK FACILITY RFI

AREA DESIGNATION[1]	FORMER DESIGNATION[3]	DESCRIPTION	SOIL BORINGS COMPLETED	STATUS
SWMU 32	None	Copper Matte Storage Area	27	IM
SWMU 33[4]	Charging Area	Old Sinter Storage Area	5	Active
SWMU 34[4]	None	BDC Building Location	--	Closed
SWMU 35	None	Area North of the Laboratory	5	Inactive
SWMU 36	None	Area South of the Refinery	3	Active
SWMU 38	None	Former Grease Shed	--	Removed
SWMU 39	None	Fill with Lead Materials	--	Inactive
SWMU 40	None	Closed Landfill Northeast of Impoundment B	3	Inactive
AOC BDC	None	Native Fill Moved During Construction of the BDC Building	1	Inactive
AOC A	None	Fill North of Impoundment A Dam	5	Inactive
AOC B	None	Fill Northeast of the Powder Magazine	3	Inactive
AOC C	None	Area East of the Sedimentation Chamber	3	Inactive

1 Solid Waste Management Unit (SWMU) number designation as presented in Section A of the Doe Run Company's Special Permit Condition VII (U.S. EPA October 28, 1989). Areas of concern (AOCs) A, B, C, and BDC, and SWMUs 39 and 40 were identified subsequent to publication of October 28, 1989 Special Permit Condition VII.

2 Integrity of SWMU with regard to the potential release of contamination documented with history of unit and photographs.

3 Nomenclature used in RFA Report and RFI Work Plan.

4 Technically, these units are considered AOCs because they are/were the location of in-process materials, not waste materials, or they are locations of transformers containing PCBs.

IM Area being addressed as part of the Interim Measures Plan.

MMWMP Area addressed by the Metallic Minerals Waste Management Plan.

TABLE 2

SUMMARY OF PREDOMINANT PROCESS MATERIALS, WASTE, AND CONTAMINATED MATERIALS PRESENT IN SWMUS INCLUDED IN THE SOILS INVESTIGATION

AREA DESIGNATION	DESCRIPTION	PROCESS MATERIALS, WASTE, AND CONTAMINATED MATERIALS
SWMU 2	Closed Construction Debris Landfill	Metals-Contaminated Fill and Landfilled Debris
SWMU 4	Closed Landfill Southwest of Impoundment E	
SWMU 6	Closed Landfill West of Impoundment E	
SWMU 5	Closed Landfill Southeast Of Impoundment E	
SWMU 40	Closed Landfill Northeast of Impoundment B	
AOC B	Fill Northeast of the Powder Magazine	
SWMU 3	Former Incinerator	Metals-Contaminated Fill Associated with Surface Storage of Waste or Process Materials
SWMU 7	Boneyard	
SWMU 13	Acid Spill Berm	
SWMU 35	Area North of the Laboratory	
AOC A	Fill North of Impoundment A Dam	
AOC BDC	Native Fill Moved During Construction of the BDC Building	
SWMU 16	Impoundment Solids Storage Area	Slag
SWMU 19	Impoundment D	
SWMU 20	Impoundment E	
AOC C	Area East of the Sedimentation Chamber	Metals-Contaminated Soil and Mixed Primary Process Material
SWMU 14	Scrubber Sludge Solids Pile	Recyclable Scrubber Sludge Solids
SWMU 29/37	Former Fuel Storage Tanks	Metals and Petroleum Hydrocarbon Contaminated Fill
SWMU 32	Copper Matte Storage Area	Copper Matte and Metals-Contaminated Fill
SWMU 33	Charging Area	Metals-Contaminated Fill and Sinter
SWMU 36	Area South of the Refinery	
SWMU 31	Covered Storage Building	

TABLE 3

SUMMARY OF SOIL QUALITY ANALYTICAL RESULTS FOR METALS
AND COMPARISON TO PROPOSED SUBPART S ACTION LEVELS
(Concentrations in mg/kg)

SWMU/ AOC	Antimony (30 mg/kg)[1]		Arsenic (80 mg/kg)[1]		Cadmium (40 mg/kg)[1]		Lead (none)[1]	
	Fill	Residuum	Fill	Residuum	Fill	Residuum	Fill	Residuum
2	<0.26-**120**	<0.22-0.91	1.1-**118**	0.32-37.1	<0.28-**352**	<0.31-**444**[2]	141-203,000	3-1,460
3	<0.23-**33.9**	0.17-11.4	3.1-**451**	7.6-35.6	1.2-**416**	0.05-5.39	93-42,900	8-19
4	<0.23-**1,140**	0.06-2.68	0.76-**342**	0.82-78.4	<0.28-**1,410**	0.21-**42.7**[3]	16-120,000	4-5,600[3]
5/16	0.18-**103**	0.17-8.36	<0.36-**557**	0.8-**839**[5]	1.53-**8,000**	0.21-**98.6**	60-185,000	16-699[4]
6	0.41-**290**	0.11-**951**	5.1-**196**	2.73-35.9	2.2-**991**	0.01-25.0	104-51,000	<1.0-242
7	0.13-**7,660**	0.15-18.5	1.0-**1,440**	<0.28-41.9	2.42-**570**	0.15-**94**[6]	164-146,000	237-11,000[6]
13	0.28-**315**	0.44-1.28	7.00-**436**	1.3-13	3.5-**880**	1.61-9.73	985-52,100	6.9-31
14	0.84-5.86	<0.79-<0.92	33.9-**119**	0.55-2.6	25.5-**2,690**	1.2-**50.7**[7]	38,300-247,000	13.9-703[7]
19	--	0.74-4.87	--	0.42-20.0	--	0.44-2.63	--	6-742
20	--	0.75-14.1	--	13.0-52.4	--	0.62-1.92	--	9-205
29/37	0.11-3.94	0.50-15.2	3.58-**190**	3.13-42.3	10.7-**378**	0.86-8.74	308-79,700	2-487
31	0.07-**50.8**	0.51-24.7	1.76-**124**	2.88-4.94	0.76-**514**	2.06-**50.7**	2.2-171,000	24-892
32	<0.23-**9,430**	<0.23-**713**	4.22-**4,860**	<0.06-**7,100**	0.837-**1,210**	<0.2777-**129**	27-180,000	7-33,900
33	2.84-**316**	0.48-10.9	18.4-**1,130**	4.22-34.7	11.2-**591**	0.32-**60.9**	7,510-148,000	6-11,800
35	<0.46-8.73	<0.43-1.2	1.9-**245**	0.63-13.8	0.16-**72.1**	0.12-**177**	18-64,000	63-21,050[8]
36	<0.79-11.6	0.87-1.72	0.45-**242**	15.9-17.4	0.33-**153**	0.04-0.46	10-54,000	11-28
40	<0.86-3.10	0.19-1.85	1.4-39.9	3.6-19.9	9.5-**96.5**	4.45-**307**	316-11,800	<1-40
A	<0.23-20.6	0.23-4.8	1.2-65.1	1.16-19.7	<0.27-**200**	<0.58-32.3	3-8,100	21-4,640
B	0.52-3.5	0.23-1.13	4.2-**188**	1.15-6.52	3.2-**602**	3.26-**68.1**	1,200-73,100	38-179

TABLE 3 (Cont.)

SUMMARY OF SOIL QUALITY ANALYTICAL RESULTS FOR METALS
AND COMPARISON TO PROPOSED SUBPART S ACTION LEVELS
(Concentrations in mg/kg)

SWMU/ AOC	Antimony (30 mg/kg)[1]		Arsenic (80 mg/kg)[1]		Cadmium (40 mg/kg)[1]		Lead (none)[1]	
	Fill	Residuum	Fill	Residuum	Fill	Residuum	Fill	Residuum
C	0.65-3.48	0.53-5.15	10.9-**616**	0.02-28.7	1.62-**302**	1.64-26.2	155-11,200	34-1,650
BDC	0.63-3.49	0.28	1.05-21.7	8.95	13.1-38.3	1.49	1,310-10,500	9.7

[1] Proposed Subpart S action Levels. Exceedences of these action levels are shown in bold print.

[2] One of 11 residuum samples from SWMU 2 had a Cd concentration greater than 40 mg/kg.

[3] Sample 4-22-2 is a shallow sample from a location where landfill material was not encountered. It contained anomalously high lead (5,600 mg/kg) and cadmium (42.7 mg/kg) concentrations. It is the only residuum sample from this SWMU with a cadmium concentration exceeding the proposed action level. The next highest lead concentration for a SWMU 4 residuum sample was 536 mg/kg.

[4] These results do not include two SWMU 5/16 residuum samples with lead concentrations of 10,500 and 154,000 mg/kg that were likely the results of cross-contamination during sampling.

[5] Only 1 of 30 residuum samples from SWMU 5/16 (Sample 5/16-10-19) contained an arsenic concentration exceeding the proposed action level.

[6] Sample 7-5-3 contained anomalously high lead (11,000 mg/kg) and cadmium (94.0 mg/kg) concentrations. It is the only residuum sample from this SWMU with a cadmium concentration exceeding the proposed action level. The next highest lead concentration for a SWMU 4 residuum sample was 3,960 mg/kg.

[7] Sample 14-4-5 contained an anomalously high cadmium concentration (50.7 mg/kg). It is the only residuum sample from this SWMU with a cadmium concentration exceeding the proposed action level.

[8] The residuum sample from SWMU 35 with a lead concentration of 21,000 mg/kg (Sample 35-2-1) was collected at the ground surface.

TABLE 4

SUMMARY OF SOIL QUALITY ANALYTICAL RESULTS FOR DETECTED SEMIVOLATILE ORGANIC COMPOUNDS AND COMPARISON TO PROPOSED SUBPART S ACTION LEVELS
(Concentrations in mg/kg)

Parameter	SWMU 5/16		SWMU 7		SWMU 29/37	
	Landfill Material	Fill and Slag	Fill	Residuum	Fill	Residuum
Acenaphthene	ND	ND	ND	ND	<0.4-1.6	<0.4-0.2
Acenaphthylene	ND	ND	ND	ND	<0.4-0.6	<0.4-0.1
Anthracene	ND	ND	ND	ND	<0.4-0.6	<0.4-0.2
Benzo(a)anthracene	ND	ND	ND	ND	<0.4-13.0	ND
Benzo(a)pyrene	ND	ND	ND	ND	<0.4-14.0	ND
Benzo(b)fluoranthene	ND	ND	ND	ND	<0.4-4.6	ND
Benzo(k)fluoranthene	ND	ND	ND	ND	<0.4-5.0	ND
Benzo(ghi)perylene	ND	ND	ND	ND	<0.4-3.9	ND
Bis(2-ethylhexyl phthalate) (50 mg/kg)[1]	ND	ND	<0.4-7.1	<0.4-0.5	ND	ND
Chrysene	ND	ND	ND	ND	<0.4-22.0	ND
Dibenzo(ah)anthracene	ND	ND	ND	ND	<0.4-1.2	ND
Dibenzofuran	ND	ND	ND	ND	<0.4-1.0	<0.4-0.1
D-n-octylphthalate	ND	ND	<0.4-0.6	ND	ND	ND
Fluoranthene	0.9	<0.4-0.4	ND	ND	<0.4-2.1	ND
Fluorene	ND	ND	ND	ND	<0.4-4.7	<0.4-0.4
Indeno(1,2,3,cd) pyrene	ND	ND	ND	ND	<0.4-1.1	ND
Isophorone (2000 mg/kg)[1]	ND	ND	ND	ND	<0.4-0.7	ND
2-Methylnaphthalene	ND	ND	ND	ND	<0.4-54.0	<0.4-0.1
Naphthalene	ND	ND	ND	ND	<0.4-19.0	ND

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TABLE 4 (Cont.)

SUMMARY OF SOIL QUALITY ANALYTICAL RESULTS FOR DETECTED SEMIVOLATILE ORGANIC COMPOUNDS
AND COMPARISON TO PROPOSED SUBPART S ACTION LEVELS
(Concentrations in mg/kg)

Parameter	SWMU 5/16		SWMU 7		SWMU 29/37	
	Landfill Material	Fill and Slag	Fill	Residuum	Fill	Residuum
Phenanthrene	1.1	ND	ND	ND	0.4-37.0	<0.4-1.4
Pyrene	0.6	ND	ND	ND	<0.4-29.0	ND
2,4,6-Trichlorophenol (40 mg/kg)[1]	ND	ND	<.04-0.4	ND	ND	ND
Maximum Total PAHs	2.6	0.4	ND	ND	179.4[2]	2.74[3]

ND Not detected.

[1] Proposed Subpart S action levels.

[2] Sample 29/37-3-5 from 4.5 to 6.0 feet depth.

[3] Sample 29/37-3-8 from 9.0 to 10.5 feet depth.

TABLE 5

STREAM SEDIMENT QUALITY ANALYTICAL RESULTS
(METALS AND GENERAL PARAMETERS)

SAMPLE[1] NUMBER	METALS (mg/kg)				GENERAL PARAMETERS						SAMPLE LOCATION
	ANTIMONY (30 mg/kg)[3]	ARSENIC (80 mg/kg)[3]	CADMIUM (40 mg/kg)[3]	LEAD	TOC (mg/kg)	CEC (meq/100g)	pH	MOISTURE (%)	ORGANICS (%)	SOLIDS (%)	
WCC-S1	4.35	1.9	**85.6**	1030	5930	4.09	7.48	15.3	1.49	84.7	WEST CROOKED CREEK
WCC-S2	12.3	**138**	**446**	5710	15800	10.0	7.45	29.7	5.10	70.3	
WCC-S3	**94.8**	**212**	**366**	10500	30100	15.3	7.37	43.0	9.83	57.0	
WCC-S3[2]	**67.4**	**195**	**306**	9970	19600	18.1	7.38	47.8	7.74	52.2	
WCC-S4	3.1	15.3	19.3	484	10800	3.08	7.23	18.3	1.50	81.7	
ECC-S1	0.72	2.2	12	1440	6910	10.5	5.7	24.2	2.48	75.8	EAST CROOKED CREEK
ECC-S2	<0.60	13.9	11.3	4330	12600	4.4	7.5	9.1	3.28	90.9	
ECC-S3	<0.70	8.6	15.4	1490	13600	9.6	7.21	21.3	4.61	78.7	
ECC-S4	<0.79	6.8	10.6	842	8710	6.4	7.18	30.5	2.40	69.5	

1 Sample numbers refer to the branch of Crooked Creek (ECC is East Branch, WCC is West Branch) and location within that branch.

2 Duplicate sample.

3 Proposed Subpart S action levels. Exceedences of these action levels are shown in bold print.

TABLE 6

COMPARISON OF MEASURED STORMWATER CONCENTRATIONS
AND WATER QUALITY STANDARDS FOR CLASS P STREAMS

SAMPLE LOCATION	ANTIMONY			ARSENIC			CADMIUM			LEAD		
	MEASURED (µg/L)		CLASS P STANDARDS	MEASURED (µg/L)		CLASS P STANDARDS	MEASURED (µg/L)		CLASS P STANDARDS	MEASURED (µg/L)		CLASS P STANDARDS
	5/10/93	5/18/93		5/10/93	5/18/93		5/10/93	5/18/93		5/10/93	5/18/93	
WCC-1	44.2	68.7	4300[1]	1.2	7.1	20[2]	**36.5**	**76**	10-17[3]	**974**	**632**	12-29[3]
WCC-2	33.7	73.2	4300[1]	13.7	8.1	20[2]	**104**	**59**	10-17[3]	**2820**	**374**	12-29[3]
WCC-3	48.4	53.0	4300[1]	4.5	5.6	20[2]	**56**	**42**	10-17[3]	**919**	**226**	12-29[3]
WCC-4	14.8	40.4	4300[1]	<1	2.4	20[2]	**53**	**56**	10-17[3]	**64**	**148**	12-29[3]
ECC-1	10.1	161	4300[1]	4.0	**50.3**	20[2]	4.5	**144**	10-17[3]	**851**	**12500**	12-29[3]
ECC-2	<7	<5	4300[1]	**62.6**	<2	20[2]	**244**	**23**	10-17[3]	**20800**	**91.5**	12-29[3]
ECC-3	<7	<5	4300[1]	2.5	<2	20[2]	**18.5**	10	10-17[3]	**160**	**92**	12-29[3]
ECC-4	<7	<5	4300[1]	1.1	<2	20[2]	6	<5	10-17[3]	21.4	16.8	12-29[3]

[1] 4300 is lowest value applicable to Class P streams--standard based on fish consumption.

[2] Based on protection of aquatic life in general warm water fishery.

[3] Based on chronic toxicity in a general warm water fishery. Range reflects variation due to hardness.

NOTE: Class P standard for warm water fisheries obtained from Table A, 70CSR 20-7.031. Exceedences are shown in bold print.

TABLE 7

POTENTIAL CORRECTIVE ACTION TECHNOLOGIES TO BE CONSIDERED IN CMS

Soil Impacted by Air Emissions	No Action Seeding Incorporation
Soil Impacted by Direct Waste/ Process Materials Deposition	
Metals Contaminated Soil	No Action Cover/Cover Improvement Consolidate and Cap
Petroleum Contaminated Soil	No Action Landfilling Landfarming/Composting Thermal Desorption
Sediment and Surface Water	
East and West Fork Crooked Creek	No Action Continued Monitoring/Diagnosis Sediment Removal Constructed Wetland or Settling Basin
Sanitary Wastewater Lagoon	No Action Sediment Removal
Groundwater	No Action -- Alternative Concentration Limits Continued Monitoring Removal of Hydraulic Sources "Plume Management"/Institutional Controls Temporary Groundwater Extraction and Treatment

Summary Report

Figures

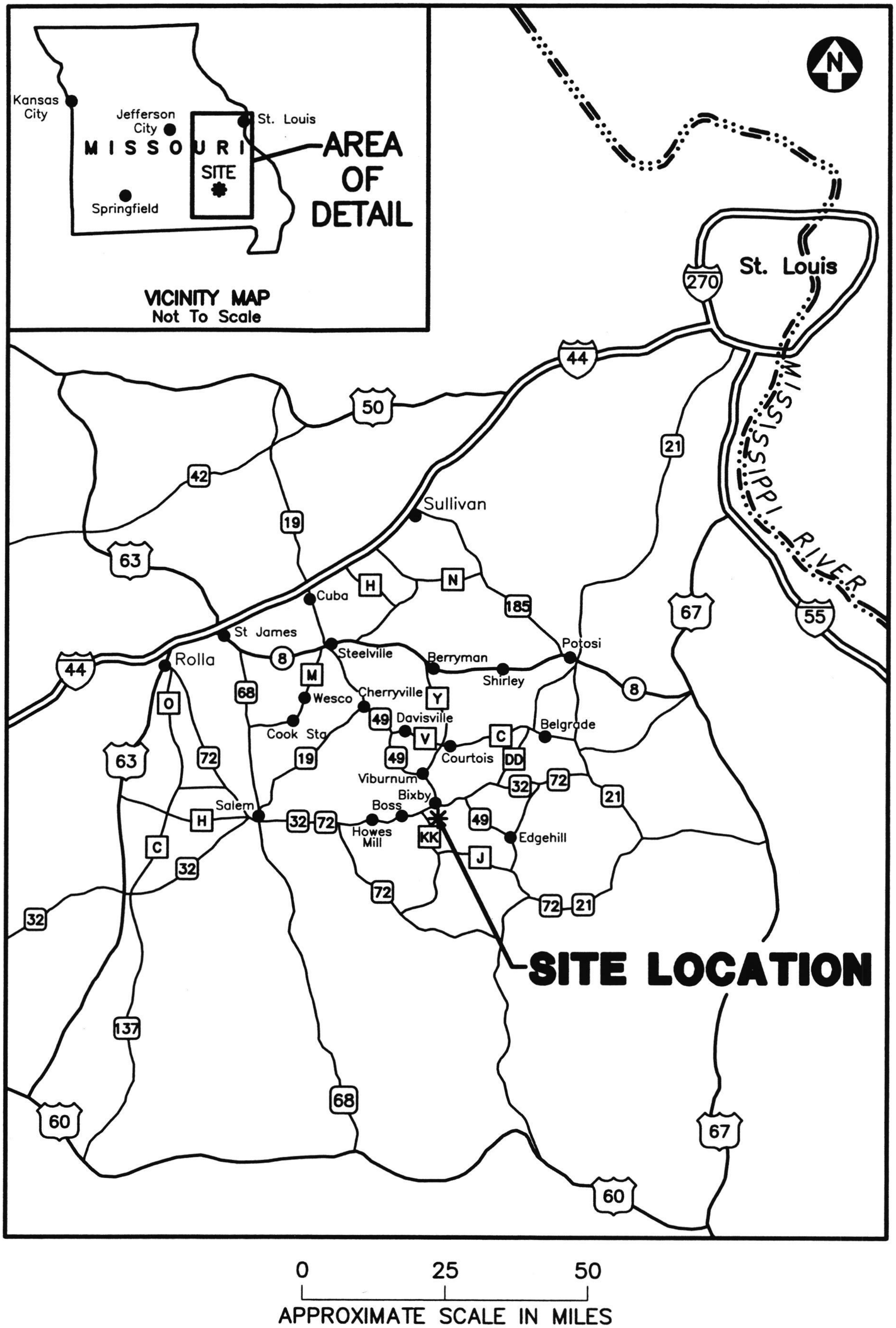
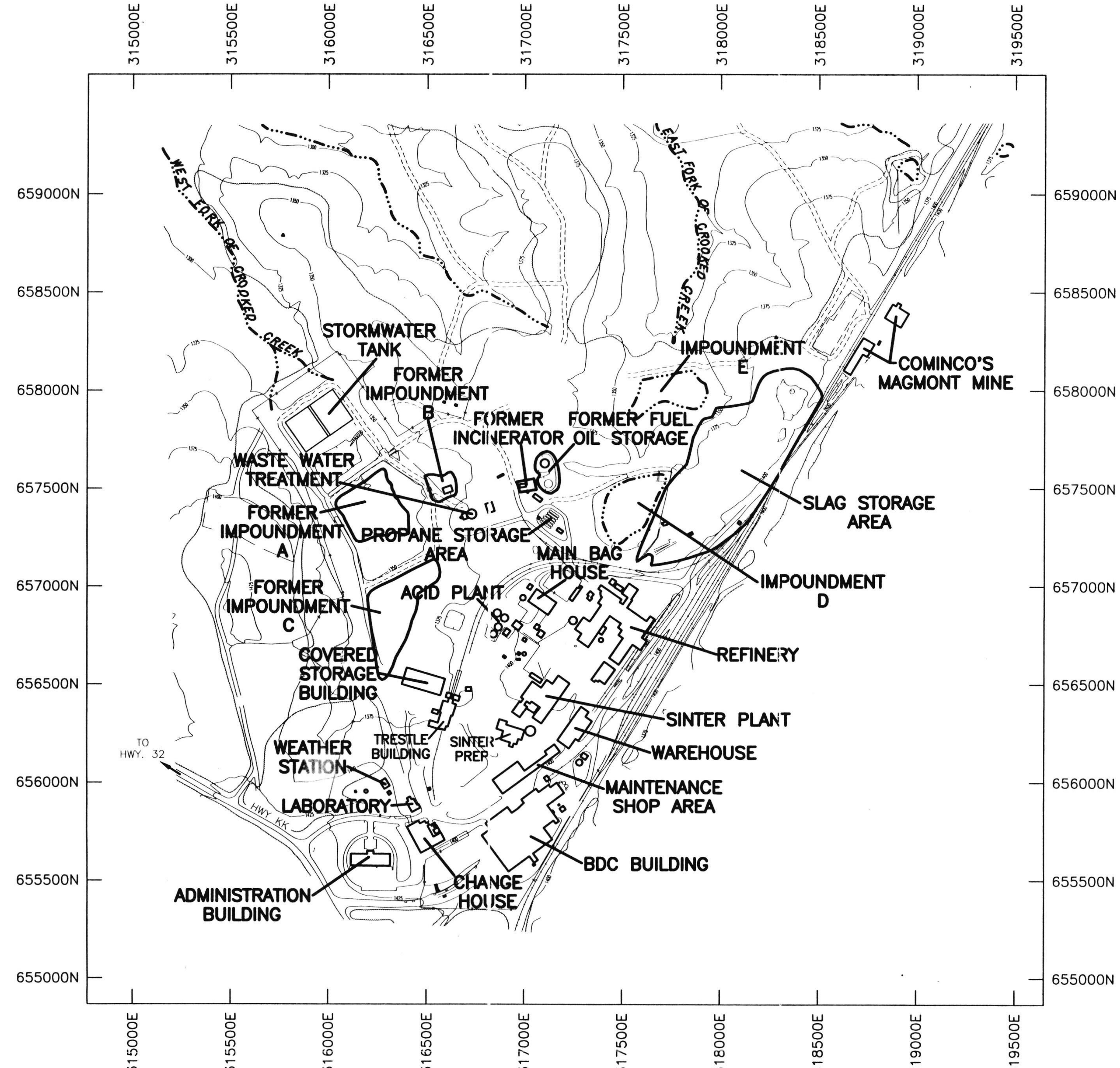
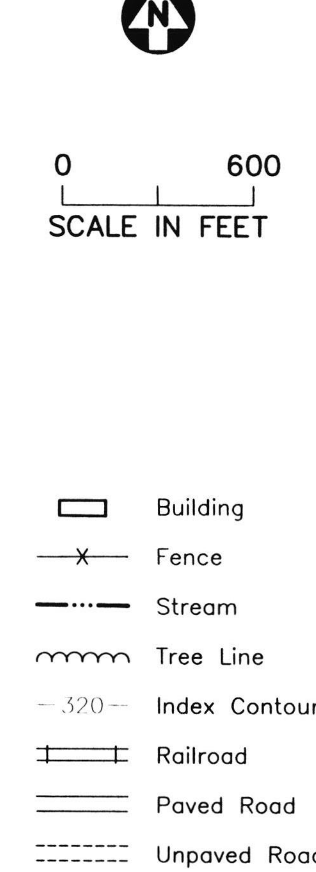


Figure 1
SITE LOCATION MAP

John Warner C:\PROJECTS\2534005\F-1 1.00 03/30/1994 17:04:07

rjw C:\PROJECTS\2534005\doerun\sitemap 600.00 08/10/1993 14:10:39





ORIGIN OF BASE MAP

NOTE: Plan detail (auto plot) from photogrammetric digital data. Contours were compiled as digital string data directly from the stereo plotter (string formed by X, Y, Z coordinates). Coordinates are Missouri State Plane Coordinates.

PHOTOGRAMMETRIC MAP

Prepared for:	Prepared by:
Doe Run Company	Walker & Associates 1650 Headland Dr. Fenton MO 63026

Scale: 1=200 Contour Int.: 5' Photos Flown: 3-28-93

Control Datum: Hor. Ver.

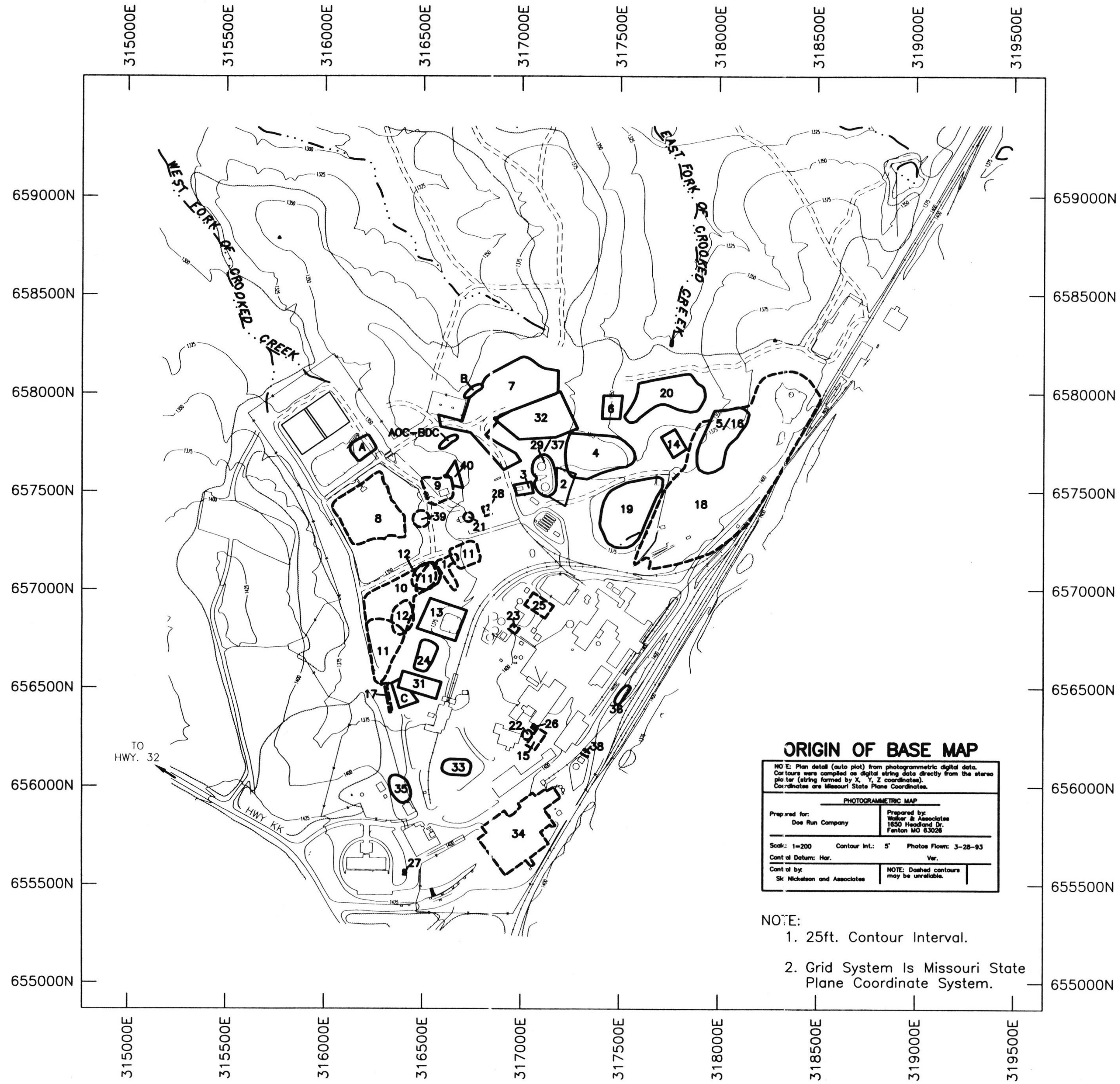
Control by:	
Sid Nickelson and Associates	NOTE: Dashed contours may be unreliable.

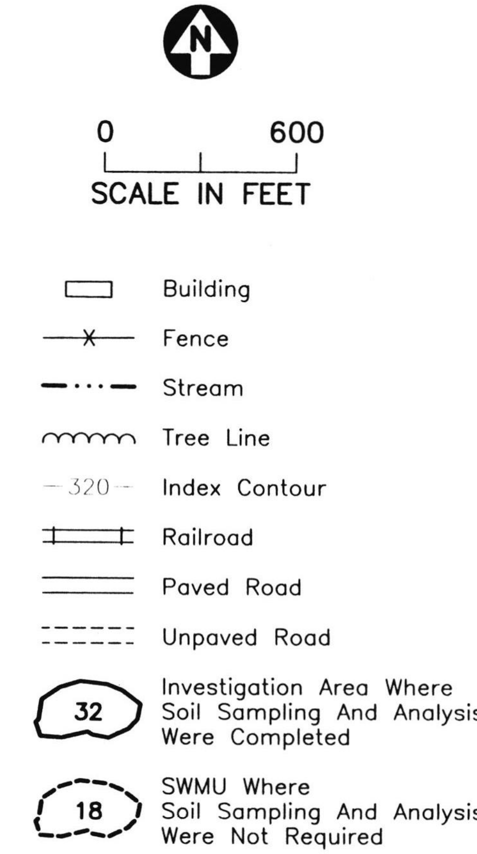
NOTE:

1. 25ft. Contour Interval.
2. Grid System Is Missouri State Plane Coordinate System.

Figure 2
SITE MAP
The Doe Run Company Buick Facility

rjw c:\projects\2534005\doerun\LOCATION 600.00 08/10/1993 11:00:00





AREA DESINATION	FORMER DESINATION	DESCRIPTION
SWMU 1	Unit B	Former Baghouse Disposal Area
SWMU 2	Unit D	Closed Construction Debris Landfill
SWMU 3	Unit H	Former Incinerator
SWMU 4	Unit I	Closed Landfill Southwest of Impoundment E
SWMU 5/16	Units J and K	Closed Landfill Southeast of Impoundment E (Unit 5) and Impoundment Solids Storage Area (Unit 16)
SWMU 6	Unit M	Closed Landfill West of Impoundment E
SWMU 7	Unit N	The Boneyard
SWMU 8	None	Impoundment A
SWMU 9	None	Impoundment B
SWMU 10	None	Impoundment C
SWMU 11	Unit A	Gypsum Disposal Area
SWMU 12	Unit C	Acid Plant Water Discharge Area
SWMU 13	Unit E	Acid Spill Berm
SWMU 14	Unit F	Sedimentation Chamber and Scrubber Sludge Solids Pile ('Rice Paddies')
SWMU 15	Unit G	Scrubber Sump
SWMU 17	Unit L	Sedimentation Chamber
SWMU 18	Unit O	Slag Storage Area
SWMU 19	None	Impoundment D
SWMU 20	None	Impoundment E
SWMU 21	None	Main Wastewater Treatment Plant
SWMU 22	None	Scrubber Solids Thickener System
SWMU 23	None	Acid plant wastewater neutralization system
SWMU 24	None	Sanitary Wastewater Lagoons
SWMU 25	None	Main Baghouse
SWMU 26	None	Stack crusher baghouse
SWMU 27	None	Office waste burning pit
SWMU 28	None	Baghouse bag/equipment wash building
SWMU 29/37	None	Former Fuel Storage Tanks
SWMU 30	None	Transformers containing PCBs(5; Not Located On Figure)
SWMU 31	None	Covered Storage Building
SWMU 32	None	Copper Matte Storage Area
SWMU 33	Charging Area	Old Sinter Storage Area
SWMU 34	None	BDC Building Area Soils
SWMU 35	None	Area North of the Laboratory
SWMU 36	None	Area South of the Refinery
SWMU 38	None	Former Grease Shed
SWMU 39	None	Fill with Lead Materials
SWMU 40	None	Closed Landfill Northeast of Impoundment B
AOC BDC	None	Native Fill Moved During Construction of the BDC Building
AOC A	None	Fill North of Impoundment A Dam
AOC B	None	Fill Northeast of the Powder Magazine
AOC C	None	Area East of the Sedimentation Chamber

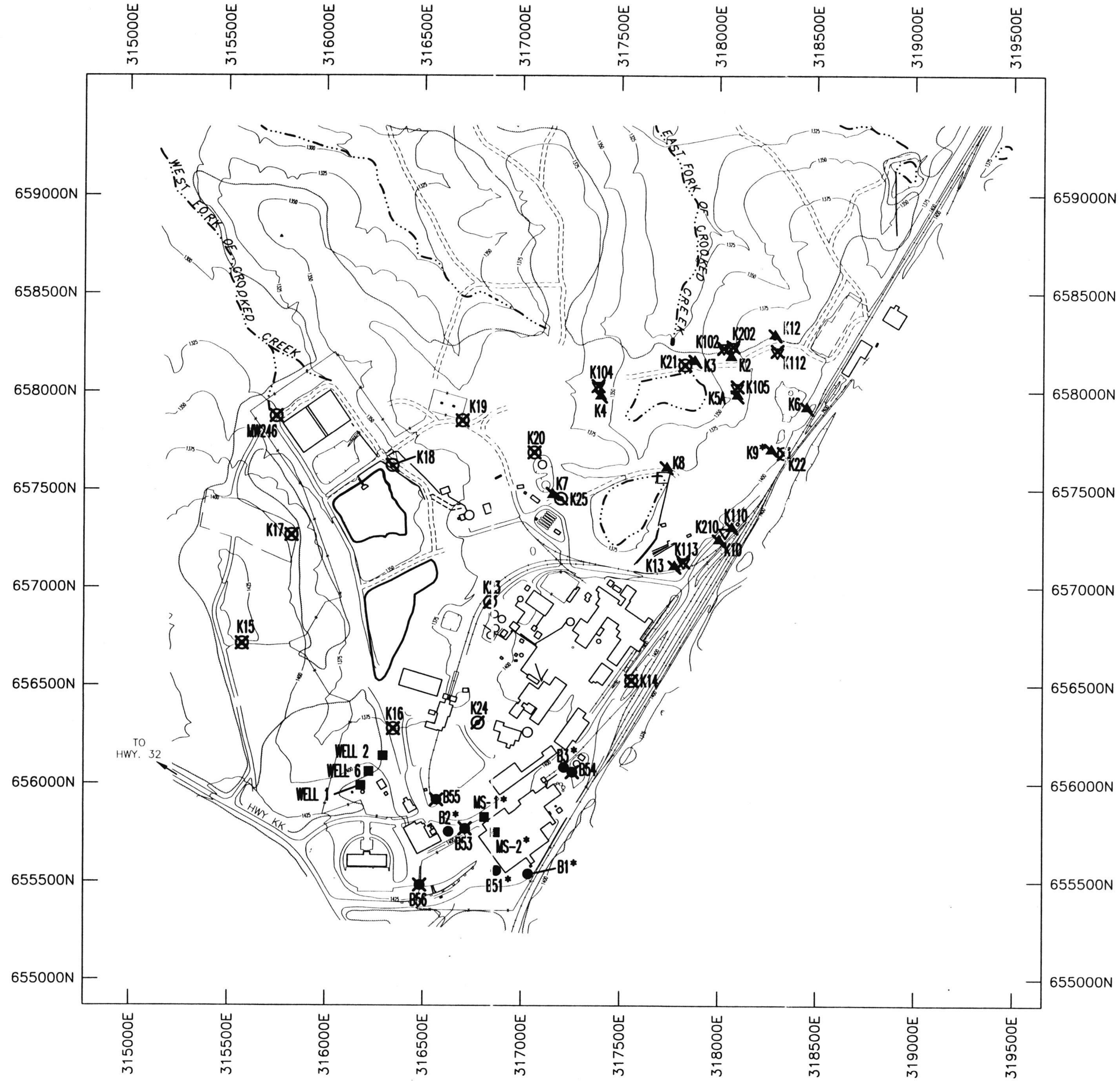
NOTE:

Solid Waste Management Unit (SWMU) number designation as presented in Section A of the Doe Run Company's Special Permit Condition VII (U.S. EPA October 28, 1989). Areas of concern (AOC's) A, B, C, and BDC, and SWMUs 39 and 40 were identified subsequent to publication of October 28, 1989 Special Permit Condition VII.

Figure 3

SOLID WASTE MANAGEMENT UNIT AND AREA OF CONCERN LOCATIONS

The Doe Run Company Buick Facility



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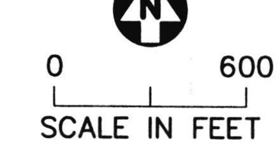


K202 Slag Storage Area Monitoring Well (2-Inch Diameter)

K21 RFI Monitoring Well

K8 Slag Storage Area Monitoring Well (4-Inch Diameter)

B53 BDC Building RCRA Detection Monitoring System Monitoring Well

WELL 2 Water Supply Well

Abandoned Well

Upper Residuum Monitoring Well

Lower Residuum/Upper Bedrock Monitoring Well

Bedrock Monitoring Well

Building

Fence

Stream

Tree Line

320 Index Contour

Railroad

Paved Road

Unpaved Road

ORIGIN OF BASE MAP

NOTE: Plan detail (auto plot) from photogrammetric digital data. Contours were compiled as digital string data directly from the stereo plotter (string formed by X, Y, Z coordinates). Coordinates are Missouri State Plane Coordinates.

PHOTOGRAMMETRIC MAP

Prepared for: Doe Run Company	Prepared by: Walker & Associates 1650 Headland Dr. Fenton MO 63026
Scale: 1=200 Contour Int.: 5'	Photos Flown: 3-28-93
Control Datum: Hor.	Ver.
Control by: Sid Nickelson and Associates	NOTE: Dashed contours may be unreliable.

NOTE:

1. Ground Surface Contour Interval Is 25 Feet.
2. Grid System Is Missouri State Plane Coordinate System.

Figure 4

MONITORING WELL LOCATIONS

The Doe Run Company Buick Facility

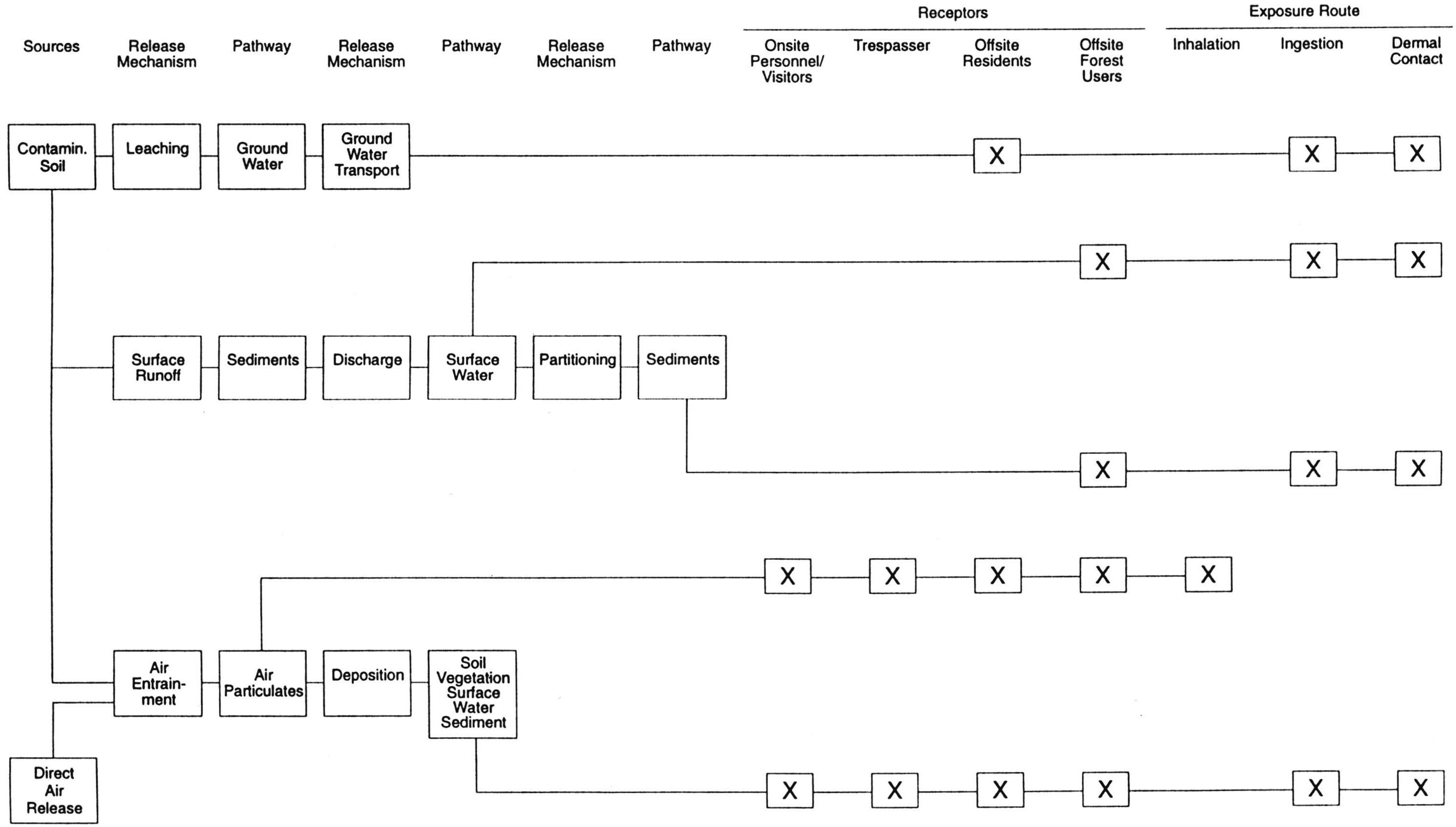
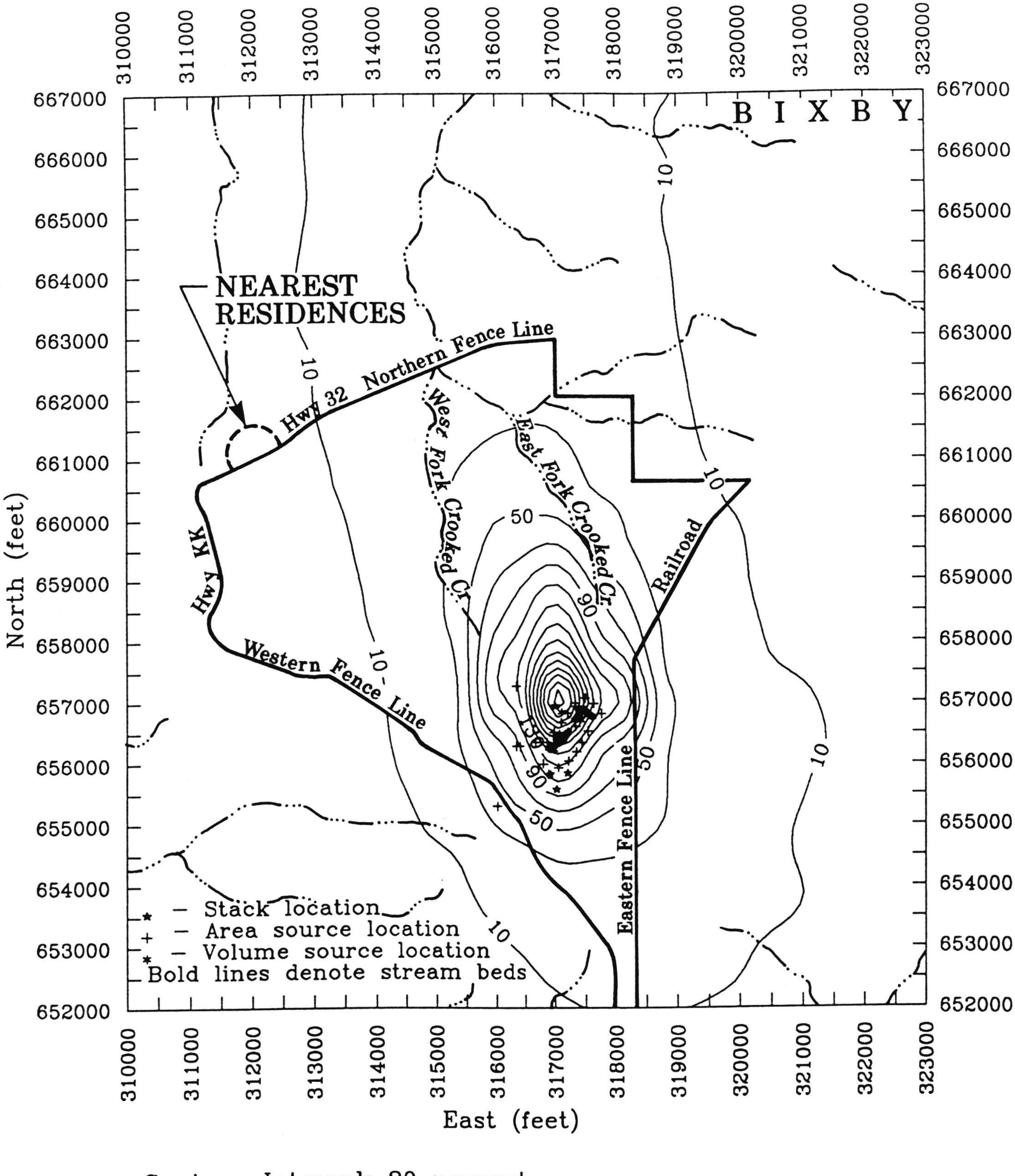


Figure 5

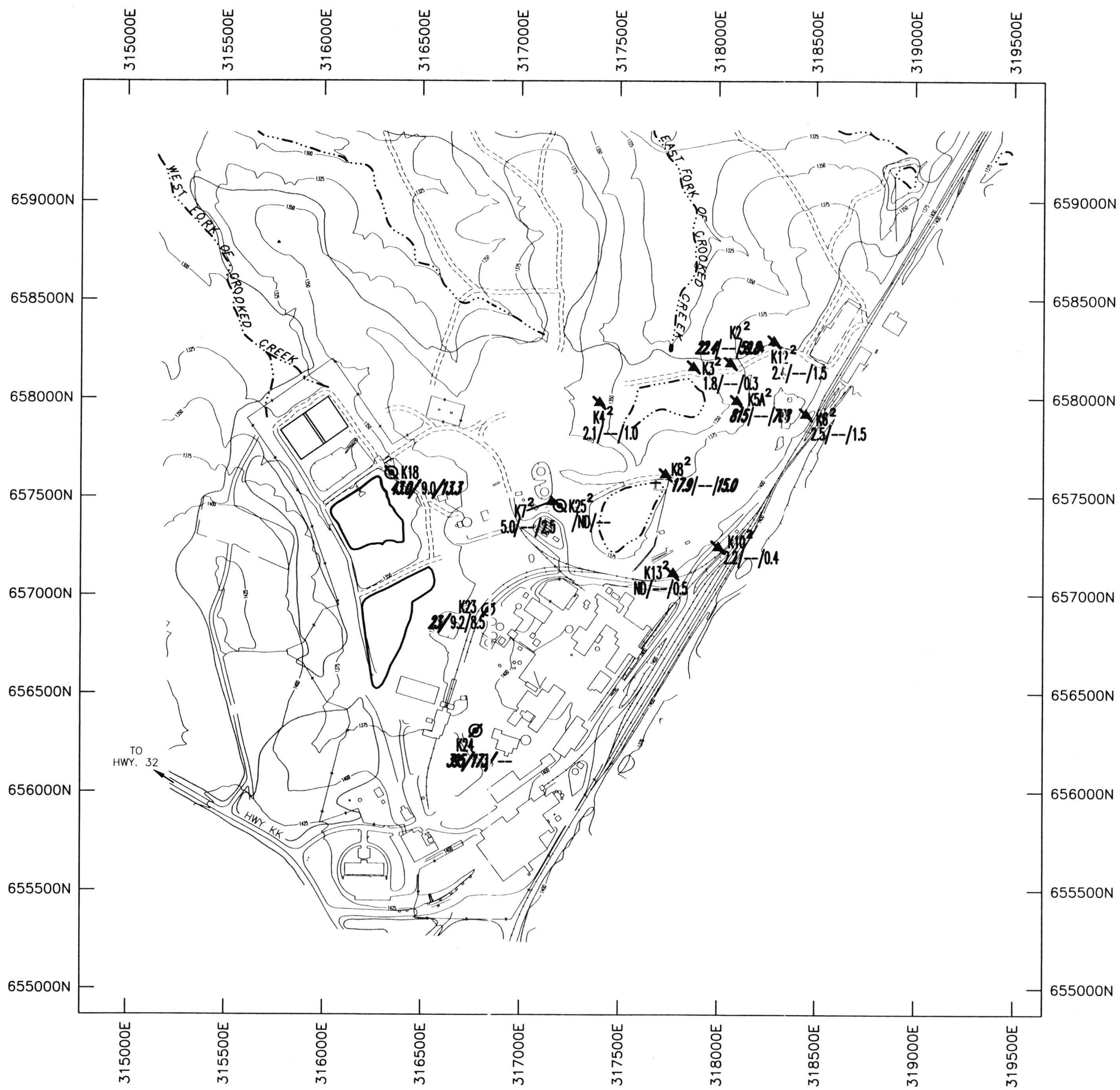
HUMAN EXPOSURE PATHWAY ANALYSIS



Contour Interval: 20 percent

Figure 6

THEORETICAL SOIL LEAD CONCENTRATIONS AS A PERCENT OF MAXIMUM FENCE LINE CONCENTRATION



0 600
SCALE IN FEET

K21 RFI Monitoring Well

K8 Slag Storage Area Monitoring Well (4-Inch Diameter)

Upper Residuum Monitoring Well

Lower Residuum/Upper Bedrock Monitoring Well

Building

Fence

Stream

Tree Line

320 Index Contour

Railroad

Paved Road

Unpaved Road

1.8/ND/0.3 Groundwater Unfiltered Cadmium Concentration (ug/L)
MAY, 1993
SEPTEMBER, 1993
JANUARY, 1994

22.4 Detected Concentrations Higher Than Maximum Groundwater Contaminant Level[1]

2.2 Detected Concentrations Equal To Or Less Than MCL

-- Not Analyzed

ND Not Detected

[1] U.S. EPA Maximum Groundwater Concentration Limit For Cadmium is 10.0 ug/L (40 CFR 264.94 [App 2] July 1, 1992).

[2] Monitoring Well Screened Across Residuum-Bedrock Contact.

* Estimated Value, QA/QC Criteria Not Met.

ORIGIN OF BASE MAP

NOTE: Plan detail (auto plot) from photogrammetric digital data. Contours were compiled as digital string data directly from the stereo plotter (string formed by X, Y, Z coordinates). Coordinates are Missouri State Plane Coordinates.

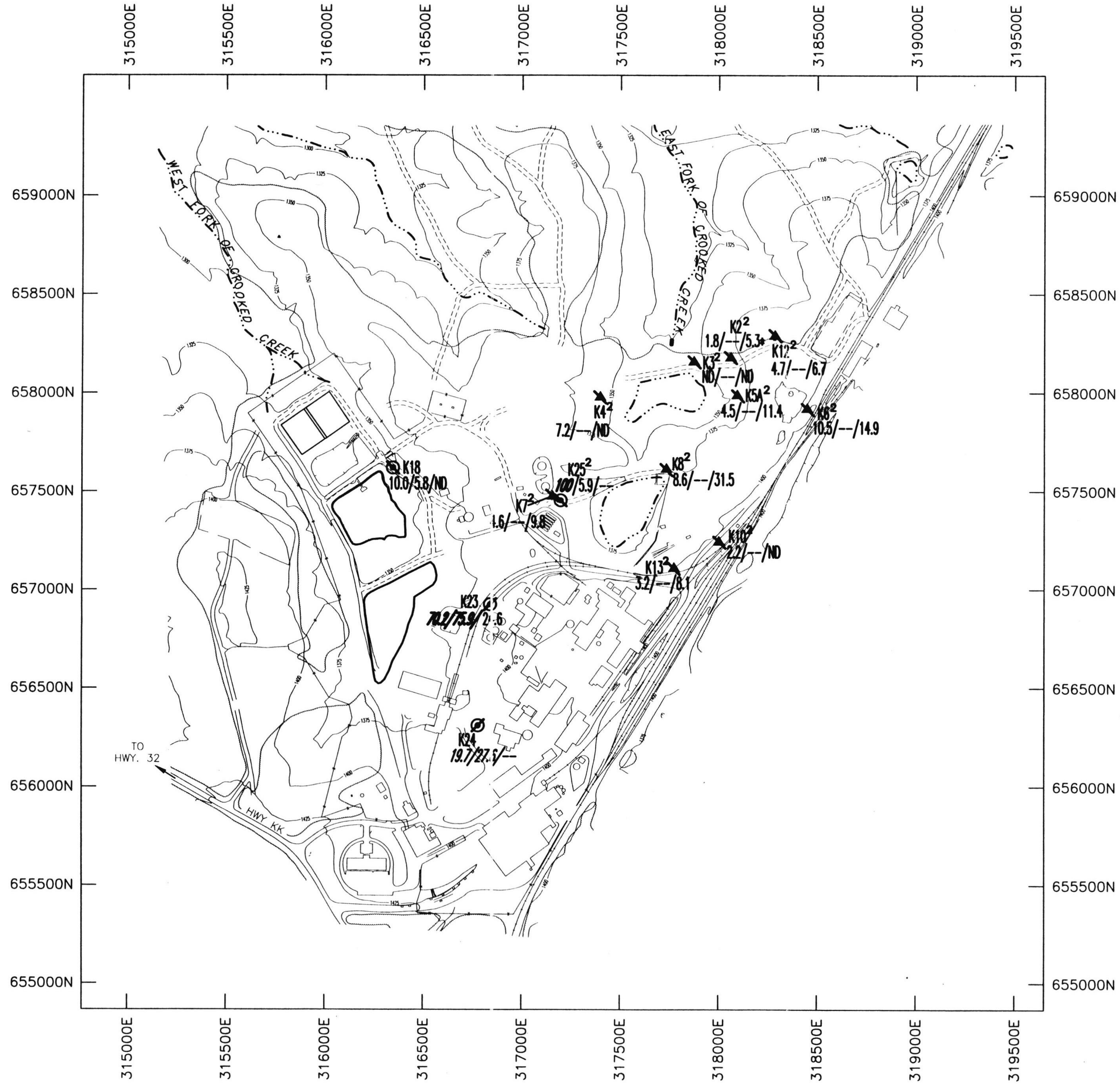
PHOTOGRAMMETRIC MAP

Prepared for: Doe Run Company	Prepared by: Walker & Associates 1650 Headland Dr. Fenton MO 63026
Scale: 1=200 Contour Int.: 5' Photos Flown: 3-28-93	
Control Datum: Hor. Ver.	
Control by: Sid Nickelson and Associates	NOTE: Dashed contours may be unreliable.

NOTE:
1. Ground Surface Contour Interval Is 25 Feet.
2. Grid System Is Missouri State Plane Coordinate System.

Figure 7
GROUNDWATER QUALITY
(UNFILTERED CADMIUM – RESIDUUM)
The Doe Run Company Buick Facility

rjw C:\PROJECTS\2534005\DRC\D-CADR 600.00 01/27/1994 14:10:39



0 600
SCALE IN FEET

K21 RFI Monitoring Well

K8 Slag Storage Area Monitoring Well (4-Inch Diameter)

Upper Residuum Monitoring Well

Lower Residuum/Upper Bedrock Monitoring Well

Building

Fence

Stream

Tree Line

320 Index Contour

Railroad

Paved Road

Unpaved Road

8.6/--/36.5 Groundwater Unfiltered Lead Concentration (ug/L)
MAY, 1993
SEPTEMBER, 1993
JANUARY, 1994

100 Detected Concentrations Higher Than Maximum Groundwater Contaminant Level[1]

8.6 Detected Concentrations Equal To Or Less Than MCL

-- Not Analyzed

ND Not Detected

[1]U.S. EPA Maximum Groundwater Concentration Limit For Lead Is 50.0 ug/L (40 CFR 264.94 [App 2] July 1, 1992).

[2]Monitoring Well Screened Across Residuum-Bedrock Contact.

*Estimated Value, QA/QC Criteria Not Met.

ORIGIN OF BASE MAP

NOTE: Plan detail (auto plot) from photogrammetric digital data. Contours were compiled as digital string data directly from the stereo plotter (string formed by X, Y, Z coordinates). Coordinates are Missouri State Plane Coordinates.

PHOTOGRAMMETRIC MAP

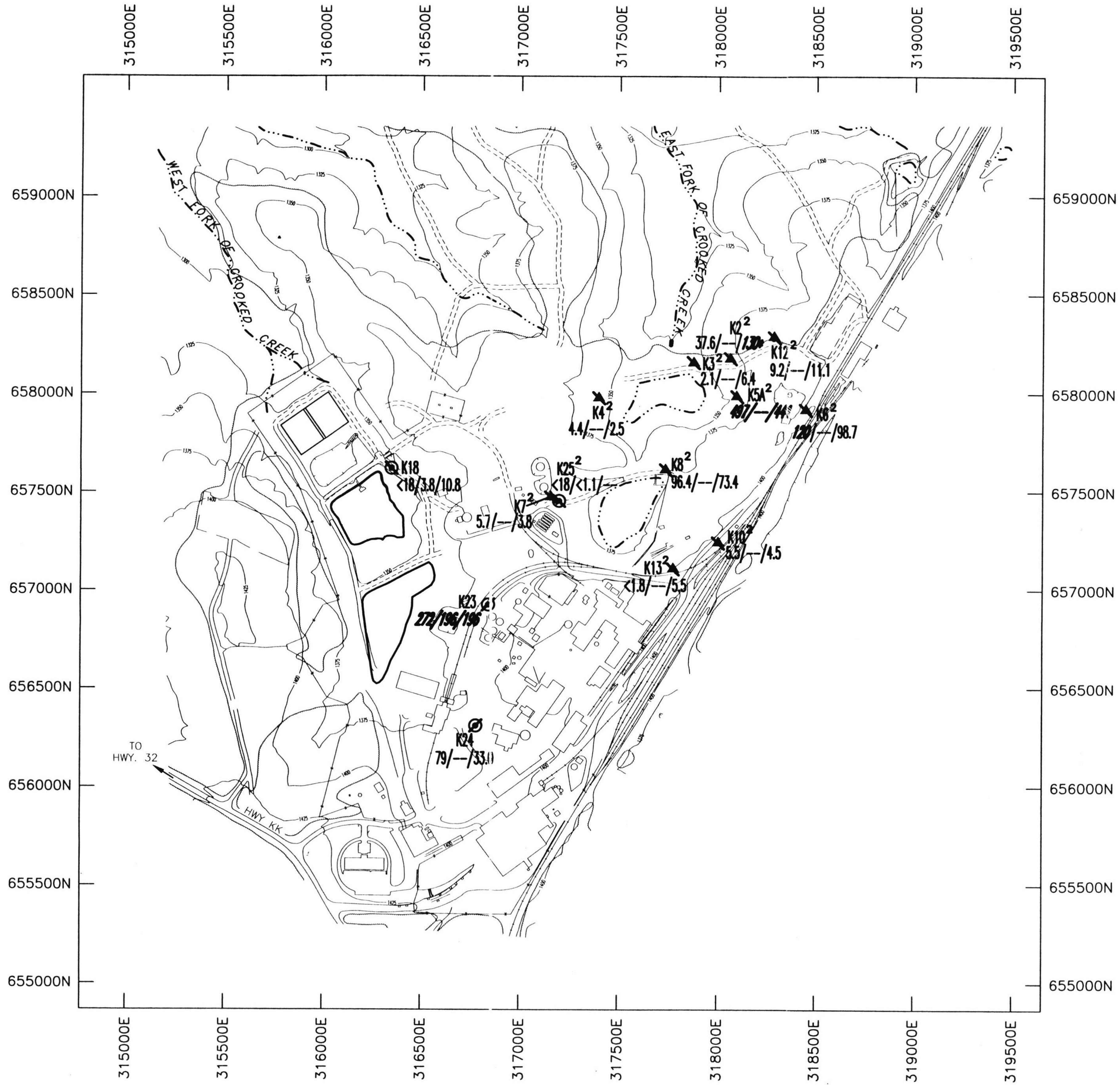
Prepared for: Doe Run Company	Prepared by: Walker & Associates 1650 Headland Dr. Fenton MO 63026
Scale: 1=200 Contour Int.: 5'	Photos Flown: 3-28-93
Control Datum: Hor.	Ver.
Control by: Sid Nickelson and Associates	NOTE: Dashed contours may be unreliable.

NOTE:
1. Ground Surface Contour Interval Is 25 Feet.
2. Grid System Is Missouri State Plane Coordinate System.

Figure 8
GROUNDWATER QUALITY
(UNFILTERED LEAD - RESIDUUM)
The Doe Run Company Buick Facility

rjw C:\PROJECTS\2534005\DRC\D-LEDR 600.00 01/27/1994 14:10:39

rjw C:\PROJECTS\2534005\DRC\d-nickl 600.00 01/27/1994 14:10:39



0 600
SCALE IN FEET

K21	RFI Monitoring Well
K8	Slag Storage Area Monitoring Well (4-Inch Diameter)
/	Upper Residuum Monitoring Well
\	Lower Residuum/Upper Bedrock Monitoring Well
	Building
	Fence
	Stream
	Tree Line
320	Index Contour
	Railroad
	Paved Road
	Unpaved Road
1.8/ND/0.3 (MAY, 1993 / SEPTEMBER, 1993 / JANUARY, 1994)	Groundwater Unfiltered Nickel Concentration (ug/L)
120	Detected Concentrations Higher Than Maximum Contaminant Level (MCL)[1]
2.2	Detected Concentrations Equal To Or Less Than MCL
--	Not Analyzed
ND	Not Detected

[1]Current MCL (January, 1994) For Nickel, As Presented In The U.S. EPA Drinking Water Statndards – 40 CFR 141.61 Is 100 ug/L.

[2]Monitoring Well Screened Across Residuum–Bedrock Contact.

*Estimated Value, QA/QC Criteria Not Met.

ORIGIN OF BASE MAP

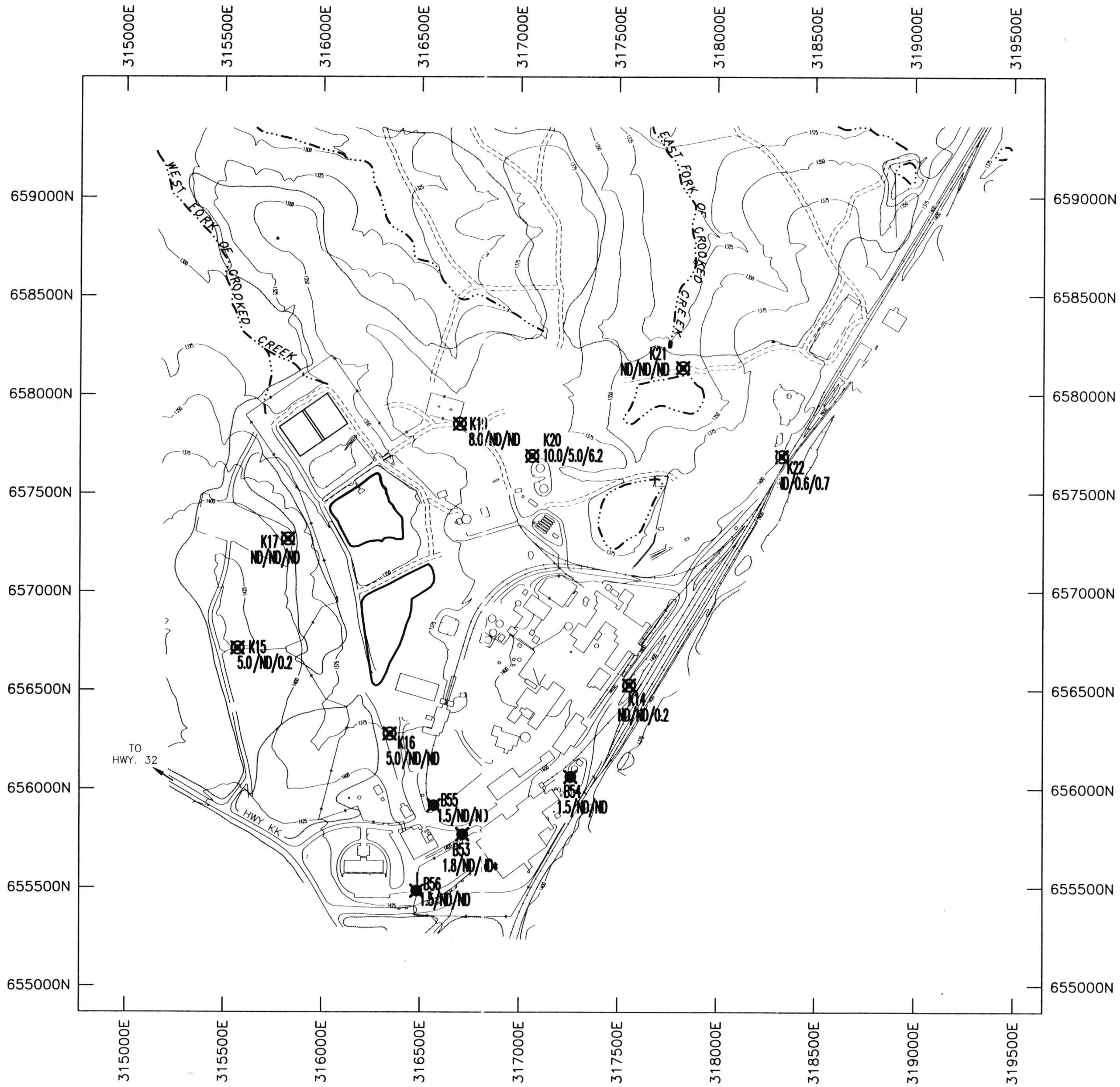
NOTE: Plan detail (auto plot) from photogrammetric digital data. Contours were compiled as digital string data directly from the stereo plotter (string formed by X, Y, Z coordinates). Coordinates are Missouri State Plane Coordinates.

PHOTOGRAMMETRIC MAP

Prepared for: Doe Run Company	Prepared by: Walker & Associates 1650 Headland Dr. Fenton MO 63026
Scale: 1=200 Contour Int.: 5'	Photos Flown: 3-28-93
Control Datum: Hor.	Ver.
Control by: Sid Nickelson and Associates	NOTE: Dashed contours may be unreliable.

NOTE:
1. Ground Surface Contour Interval Is 25 Feet.
2. Grid System Is Missouri State Plane Coordinate System.

Figure 9
GROUNDWATER QUALITY
(UNFILTERED NICKEL – RESIDUUM)
The Doe Run Company Buick Facility



rjw C:\PROJECTS\2534005\drn\D-CADB 600.00 01/27/1994 14:10:39

0 600
SCALE IN FEET

- Bedrock Monitoring Well
- K21 RFI Monitoring Well
- B53 BDC Building RCRA Detection Monitoring System Monitoring Well
- Building
- Fence
- Stream
- Tree Line
- 320 Index Contour
- Railroad
- Paved Road
- Unpaved Road
- 1.5/ND/ND (MAY, 1993 / SEPTEMBER, 1993 / JANUARY, 1994) Groundwater Unfiltered Cadmium Concentration (ug/L)
- **10.0** Detected Concentrations Higher Than Maximum Groundwater Contaminant Level[1]
- 0.6 Detected Concentrations Equal To Or Less Than MCL
- -- Not Analyzed
- ND Not Detected

[1]U.S. EPA Maximum Groundwater Concentration Limit For Cadium Is 10.0 ug/L (40 CFR 264.94 [App 2] July 1, 1992).

*Estimated Value, QA/QC Criteria Not Met.

ORIGIN OF BASE MAP

NOTE: Plan detail (auto plot) from photogrammetric digital data. Contours were compiled as digital string data directly from the stereo plotter (string formed by X, Y, Z coordinates). Coordinates are Missouri State Plane Coordinates.

PHOTOGRAMMETRIC MAP

Prepared for: Doe Run Company	Prepared by: Walker & Associates 1650 Headland Dr. Fenton MO 63026
Scale: 1=200 Contour Int.: 5'	Photos Flown: 3-28-93
Control Datum: Hor.	Ver.
Control by: Sid Nickelson and Associates	NOTE: Dashed contours may be unreliable.

NOTE:

1. Ground Surface Contour Interval Is 25 Feet.
2. Grid System Is Missouri State Plane Coordinate System.

Figure 10

GROUNDWATER QUALITY (UNFILTERED CADMIUM – BEDROCK)

The Doe Run Company Buick Facility

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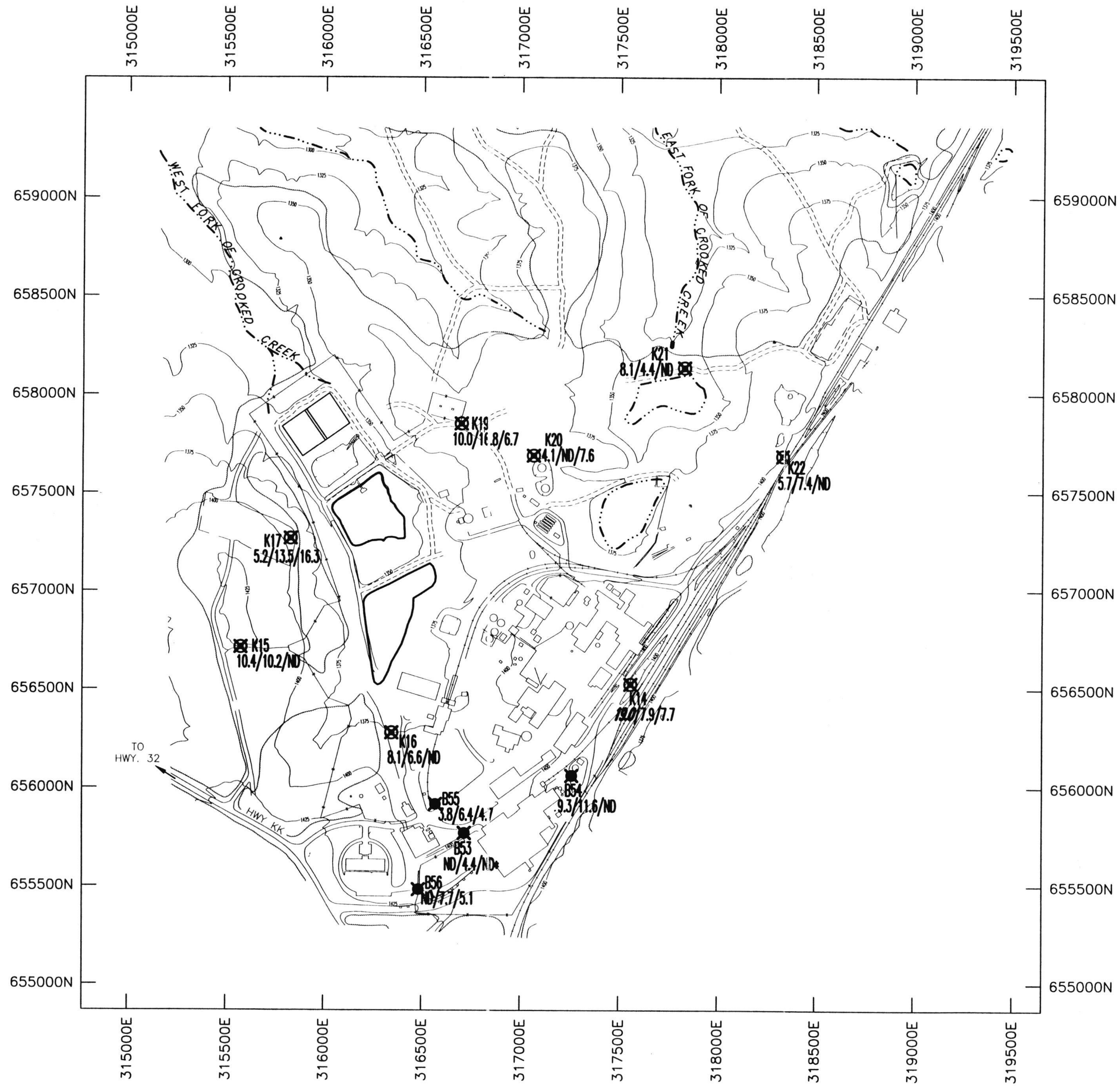


0 600
SCALE IN FEET

X	Bedrock Monitoring Well
K21	RFI Monitoring Well
B53	BDC Building RCRA Detection Monitoring System Monitoring Well
	Building
	Fence
	Stream
	Tree Line
320	Index Contour
	Railroad
	Paved Road
	Unpaved Road
8.1/4.4/ND (MAY, 1993 / SEPTEMBER, 1993 / JANUARY, 1994)	Groundwater Unfiltered Lead Concentration (ug/L)
100	Detected Concentrations Higher Than Maximum Groundwater Contaminant Level[1]
4.4	Detected Concentrations Equal To Or Less Than MCL
--	Not Analyzed
ND	Not Detected

[1] U.S. EPA Maximum Groundwater Concentration Limit For Lead Is 50.0 ug/L (40 CFR 264.94 [App 2] July 1, 1992).

* Estimated Value, QA/QC Criteria Not Met.

ORIGIN OF BASE MAP

NOTE: Plan detail (auto plot) from photogrammetric digital data. Contours were compiled as digital string data directly from the stereo plotter (string formed by X, Y, Z coordinates). Coordinates are Missouri State Plane Coordinates.

PHOTOGRAMMETRIC MAP

Prepared for: Doe Run Company	Prepared by: Walker & Associates 1650 Headland Dr. Fenton MO 63026
Scale: 1=200 Contour Int.: 5' Photos Flown: 3-28-93	
Control Datum: Hor.	Ver.
Control by: Sid Nickelson and Associates	NOTE: Dashed contours may be unreliable.

NOTE:

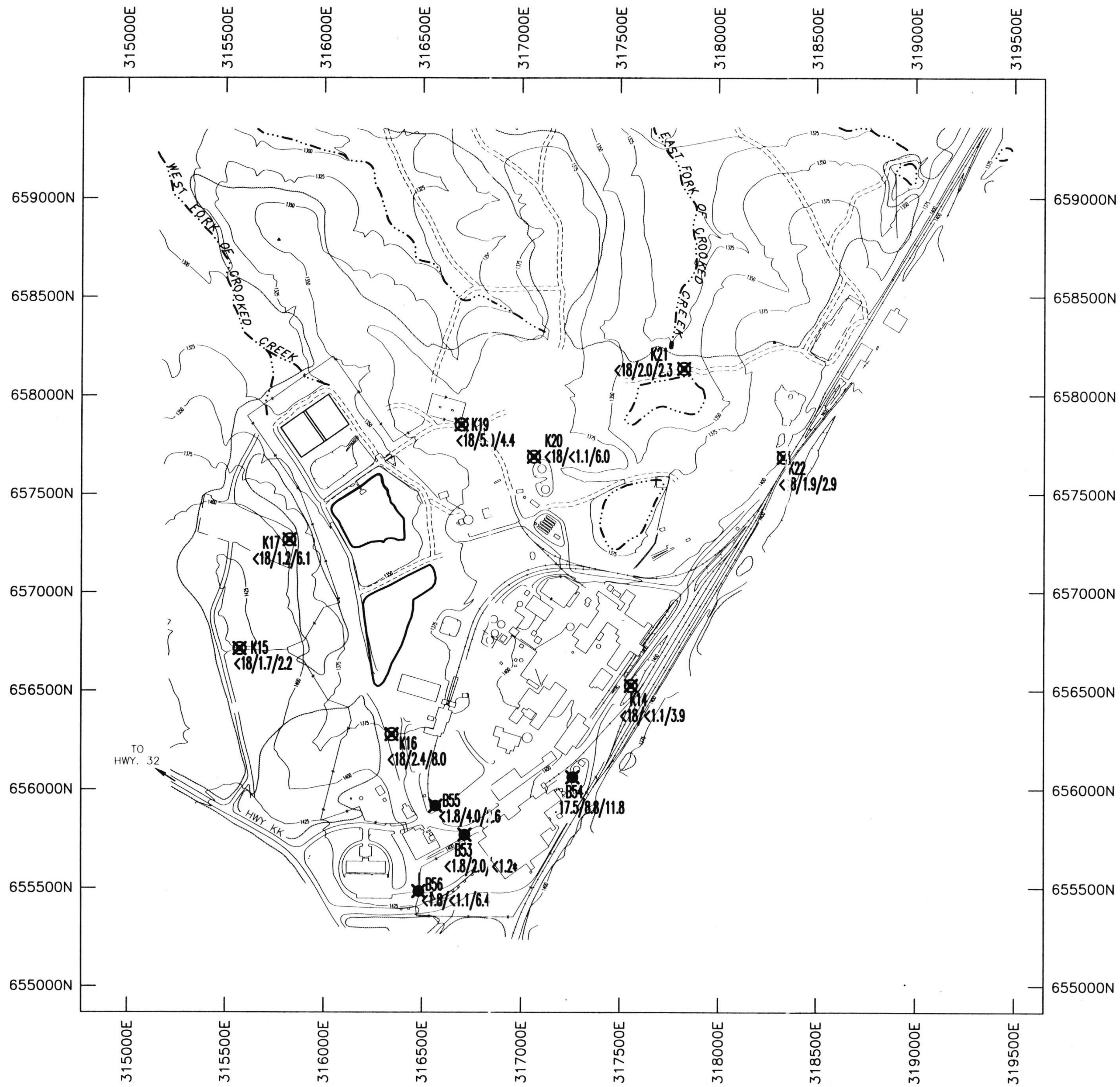
1. Ground Surface Contour Interval Is 25 Feet.
2. Grid System Is Missouri State Plane Coordinate System.

Figure 11

GROUNDWATER QUALITY (UNFILTERED LEAD – BEDROCK)

The Doe Run Company Buick Facility

rjw C:\PROJECTS\2534005\drn\D-NICBR 600.00 01/27/1994 14:10:39



0 600
SCALE IN FEET

- Bedrock Monitoring Well
- K21 RFI Monitoring Well
- B53 BDC Building RCRA Detection Monitoring System Monitoring Well
- Building
- Fence
- Stream
- Tree Line
- 320 Index Contour
- Railroad
- Paved Road
- Unpaved Road
- 17.5/8.8/11.8 (MAY, 1993 / SEPTEMBER, 1993 / JANUARY, 1994) Groundwater Unfiltered Nickel Concentration (ug/L)
- **120** Detected Concentrations Higher Than Maximum Contaminant Level (MCL)[1]
- 2.2 Detected Concentrations Equal To Or Less Than MCL
- -- Not Analyzed
- ND Not Detected

[1] Current MCL (January, 1994) For Nickel, As Presented In The U.S. EPA Drinking Water Statndards – 40 CFR 141.61 Is 100 ug/L.

[2] Monitoring Well Screened Across Residuum–Bedrock Contact.

* Estimated Value, QA/QC Criteria Not Met.

ORIGIN OF BASE MAP

NOTE: Plan detail (auto plot) from photogrammetric digital data. Contours were compiled as digital string data directly from the stereo plotter (string formed by X, Y, Z coordinates). Coordinates are Missouri State Plane Coordinates.

PHOTOGRAMMETRIC MAP	
Prepared for: Doe Run Company	Prepared by: Walker & Associates 1650 Headland Dr. Fenton MO 63026
Scale: 1=200 Contour Int.: 5'	Photos Flown: 3-28-93
Control Datum: Hor.	Ver.
Control by: Sid Nickelson and Associates	NOTE: Dashed contours may be unreliable.

NOTE:
1. Ground Surface Contour Interval Is 25 Feet.
2. Grid System Is Missouri State Plane Coordinate System.

Figure 12
GROUNDWATER QUALITY
(UNFILTERED NICKEL – BEDROCK)
The Doe Run Company Buick Facility